

PC

PRO

Not sold on Windows 10?

Switch to Linux p34



10
smart
watches
on test

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Smartwatches from £65:
which is right for you?



HOW TO SECURE CHROME

Plug the holes that put
your privacy at risk p44



Stonking £159 smartphone

The new Motorola Moto G: full review p64

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In this issue



FEATURES

COVER STORY

34 Switch to Linux

There are plenty of decent Linux alternatives to Windows 10 – not just the ubiquitous Ubuntu.

COVER STORY

44 How to secure Chrome

Does Google's browser deserve its reputation for security? We show how to make it even safer.

50 Tech weekenders

From touring a city to battling aliens – we use technology to try new experiences.

54 Save time online with IFTTT

IFTTT is a free service that can connect a huge range of devices and systems, making your life easier.

58 Program without code using Scratch

We discover that drag-and-drop programming isn't just for kids.

PROFILE

22 TransportAPI

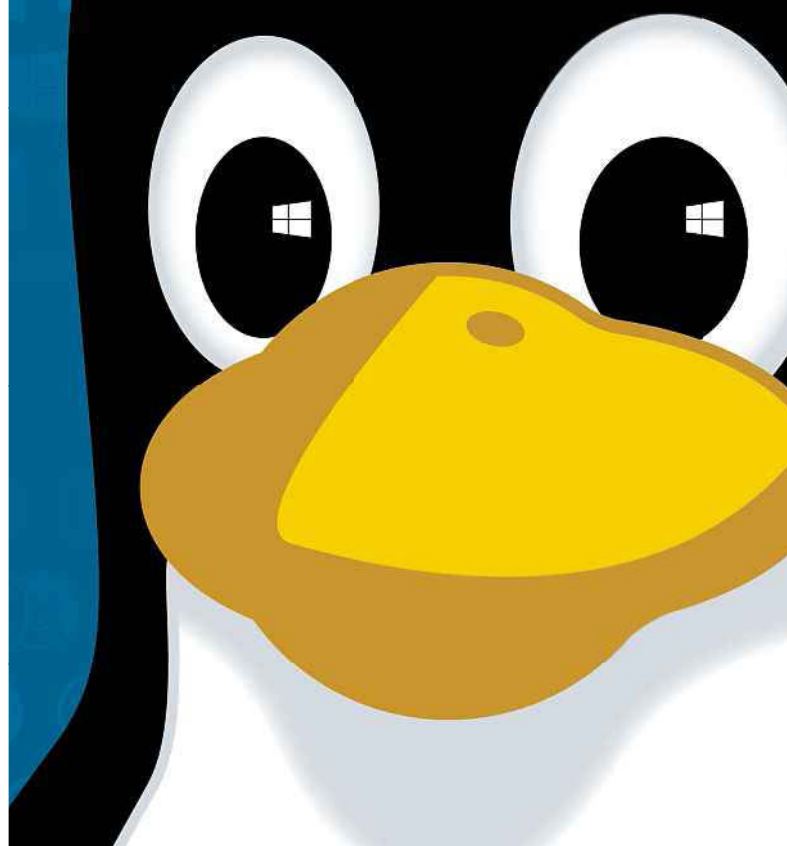
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34 Make a fresh start with Linux distros



BRIEFING

10 Fixing broadband for the final 5%

There's still work to be done in bringing broadband up to speed in rural areas.

12 Has Microsoft downgraded privacy?

We investigate controversial data-sharing features in Windows 10.

14 Intel Developer Forum 2015

We find out why Intel is focusing on the Internet of Things, rather than Windows PCs.

16 The pirate hunters are back

We reveal the full story behind the latest round of speculative invoicing.

VIEWPOINTS

24 DARIEN GRAHAM-SMITH New memory tech is a bigger deal than next-gen CPUs.

25 BARRY COLLINS Amazon should treat its staff the way it does its customers.

25 NICOLE KOBIE A simple ban on autonomous weapons isn't enough.

26 DICK POUNTAIN The ten key rules for safety-critical code, courtesy of NASA.

28 CAREERS MIKE WOODHEAD Learn what it takes to become a penetration tester.

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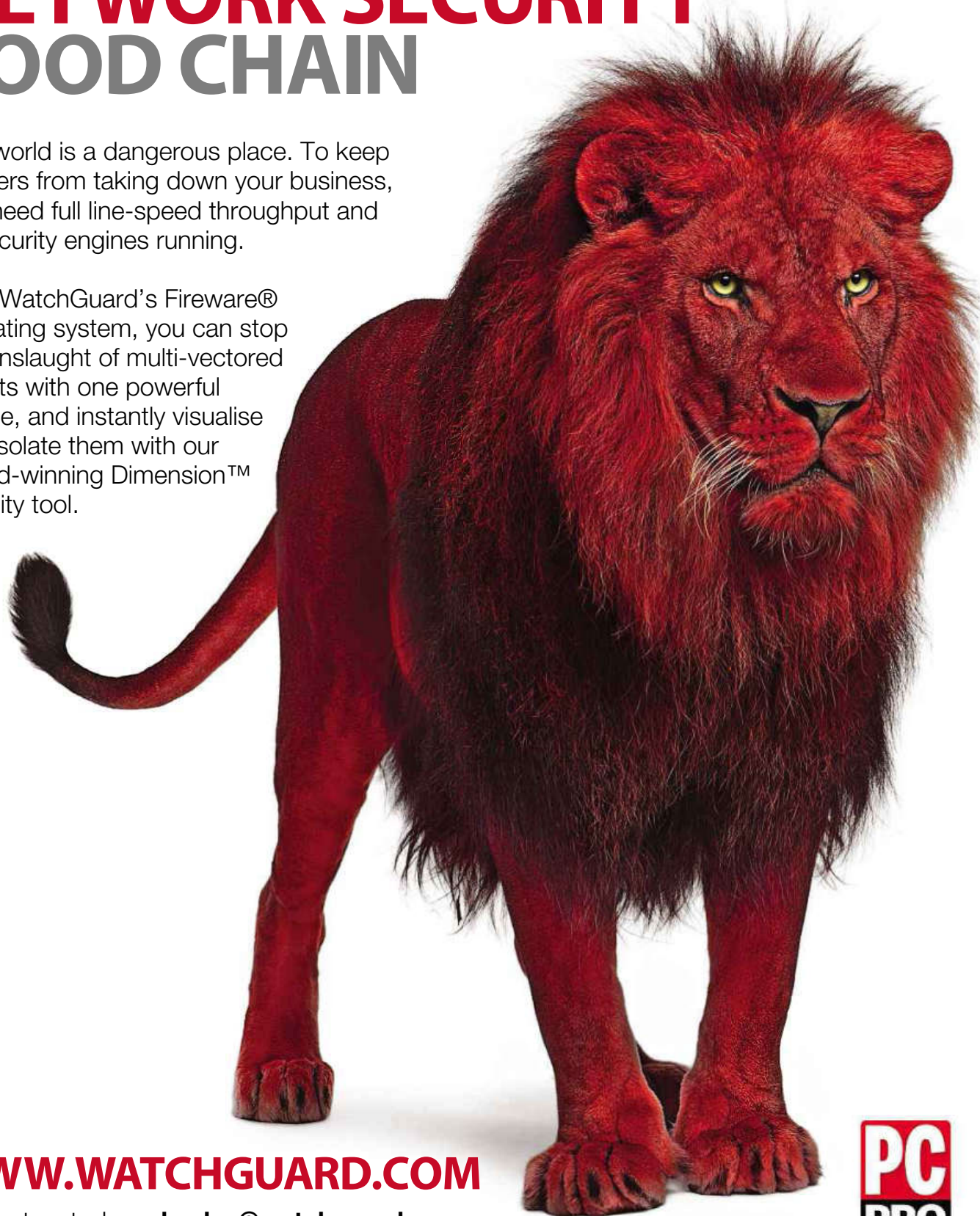




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62 The Galaxy S6 Edge+ is a rare beauty, but expect it to blow a hole in your bank balance



REVIEWS/LABS

HEADLINE REVIEWS

Samsung Galaxy S6 Edge+	62	LG Watch Urbane	83
Motorola Moto G	64	Acer Liquid Leap	84
Nokia N1	66	Asus ZenWatch	84
Acer Aspire Switch 10 E	67	Fitbit Surge	85
Asus ZenPad S 8.0 (Z580ZA)	68	Garmin Vivoactive	85
LibreOffice 5	70	Microsoft Band	88
Intel Skylake	74	Motorola Moto 360	88
		Pebble Time	89
		Sony SmartWatch 3	89

APPS

Todoist 10	76		
Google Play Books	76	BUSINESS	
You Must Build a Boat	76	Brother HL-L8350CDW	96
Pocket 6	77	Canon i-Sensys LBP7780Cx	97
Steve Reich's Clapping Music	77	HP Color LaserJet	98
Glitché	77	Enterprise M553x	99
		Oki C711WT	99
		Dell E525w	100
		WatchGuard Firebox M200	101

SMARTWATCHES

Apple Watch Sport	82		
-------------------	----	--	--



78 LABS: SMARTWATCHES COVER STORY

Are you sick of pulling your smartphone out of your pocket, but unsure which of the many smartwatches or fitness bands should adorn your wrist? We test ten of the latest models to help you find out.

REAL WORLD COMPUTING

110 JON HONEYBALL Upgrading to Windows 10 allows you to tiptoe around the smoking crater that is Windows 8, but give it a few months before taking the leap.

113 PAUL OCKENDEN Three quirky USB products have been surprisingly useful this month, from a reversible cable to a 5m-long endoscope.

116 ROBERT SCHIFFREIN It took four years to implement, but the University of Brighton's SharePoint installation now provides essential features for its 3,000 staff.

118 DAVEY WINDER Many people are distrustful of online password managers – and it seems they may have a point. So how can you keep your passwords secure?

120 STEVE CASSIDY Even Microsoft admits that a hybrid approach is best – but to make it work, you need to understand the company's unspoken rules.

REGULARS

Editor's letter	7	Subscriptions	92
The A-List	18	Geek Day Out	128
Readers' comments	32	One last thing...	130

THE NETWORK

94 Choose an A4 colour laser printer

The lasers that turn out fast, high-quality prints at a price to suit your business.

102 How can my business grow successfully?

We ask how a small company can identify and tackle the challenges that come with growth.

COVER STORY

106 Get the best from LinkedIn

We show you how to optimise your use of LinkedIn to find both staff and customers.

109 Cheat Sheet: Hyperconvergence

Far from a meaningless buzzword, it might be the best solution for your business.

FUTURES

124 The future of smart cities – now

Canary Wharf is running a series of smart-city pilot projects – are they a glimpse into the future?

127 Drone laws

Legislation often lags behind technology, but could new airspace rules ground drones or help them take to the skies?

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Editor's letter

THE SCENE: A BAR. The date: a weekday evening, summer 2015. The occasion: two old university friends, in their mid-40s, catching up. And, as usual, arguing. One of them was me.

"I still don't see the point." He was unimpressed as I showed off my new smartwatch.

"Well, what was the point of the mobile phone? The laptop? The computer? No-one sees the point at first, do they? And then they can't live without it."

He eyed me with deep suspicion over his pint of Peroni. "So you wouldn't be able to function without your watch? You'd run into your burning house, ignoring the children, and grab your watch, clutching it to your heart."

"Don't be stupid," I laughed, "I'd be wearing it. No need to dash back into the house."

For a second I can tell he wants to press the issue of whether I'd rescue the kids before my watch, but he lets it go. "Okay, let's play a game. Phone or watch?"

"Trick question, because the watch is an extension of the phone. It's like asking hand or arm. I'll take both."

"Alright. You're dashing –"

"Thank you very much."

"You're dashing for the train and realise you've left your watch charging by the bed. If you go back now you're going to miss the train and be late for work. What do you do?"

I already know the answer, having lived through this precise scenario more than once. "I carry on to work."

"Ha!"

"But I feel naked without it for the whole day."

"So go on, why? Why do you feel naked?"

And this is the crux of the matter. Why? Reasons tumble through my brain, all to do with staying fit and keeping on top of a busy work schedule, but they're tricky to pin down

in words. "Lots of reasons. At a glance, I can see how many steps I've taken that day and what my heart rate is."

"Crucial data, to be sure."

"It buzzes, you know, on my wrist to let me know I've got a meeting coming up, or if a call is coming through. Before, I missed calls because I kept my phone on silent."

"Okay, I can see how that might be useful. And I can see how it might be irritating having that thing buzz along with your phone and computer, so keep going."

"I can quickly read my messages and decide if I want to reply. And Twitter notifications. And Facebook."

"So, you're saying I should pay £300 for a text-message filter that buzzes every half-hour and tracks my heartbeat. Even though I have no reason to track my heartbeat."

"Well, they start at around £65. Look, do you remember when you first got a mobile phone? That's all it was, right? A replacement for the landline. Hardly felt life-changing, did it? It's the same for a smartwatch. You buy it thinking it's merely nice to have, but it's soon part of your daily life, whether that's at work or at home. You will, trust me, feel naked without it." I feel, at last, I've nailed it. This is what makes smartwatches so special.

He finishes his pint and rises to his feet. "Last time I trusted you we ended up freezing in a tent in Pitlochry." And with that he heads to the bar.

Safely out of earshot, I lift my watch to my mouth: "OK Google. Remind me, in two years' time, to check which model of smartwatch Stuart's using."

Tim Danton
Editor-in-chief

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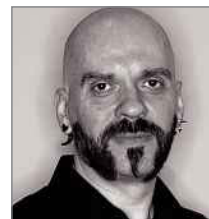
Rupert Goodwins Think you know Linux? Think again. Rupert rounds up the best distros for different types of people, plus the essential apps you need to download. See **p34**



Darien Graham-Smith Brilliant free service IFTTT can save you time and hassle by connecting your devices and systems. Darien explains how on **p54**



Robert Schifreen SharePoint has revolutionised the University of Brighton's way of working. The man in charge of the rollout shares his story on **p116**



Davey Winder Don't run scared from the myriad security threats hitting your browser: get safe. Davey provides practical advice on securing Chrome on **p44**



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What task do you wish technology could do automatically for you?

"I wish it could decide which of the thousands of photos on my PC are keepers, so I could reclaim disk space without spending hours flicking through them."

"The mundane aspects of my life – organisation, cooking, buying clothes that fit, etc."

"Writing my column!"

"I'm a big fan of to-do list apps, but I wish the technology could fill them in for me. Writing out my to-do list is the thing I often don't get done."

"I want tiny robot barber-spiders to tend to my stubble while I sleep, so I wake with a smooth, miraculously mown chin."

"I wish they'd invent a machine that sweeps away dust with the click of a button."

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Background and analysis on all the important news stories

Privacy in Windows 10

New features and settings have some users worried [p12](#)

Intel Developer Forum 2015

We reveal why Intel is focusing on the Internet of Things [p14](#)

PC Probe

The pirate hunters are back and as shady as ever [p16](#)

Fixing broadband for the final 5%

The government is touting the success of its broadband funding, but there's still work to be done in bringing broadband up to speed for rural areas, finds [Nicole Kobie](#)

AT LEAST 95% of British households will have access to fibre broadband within the next 18 months, but the battle for better broadband isn't over.

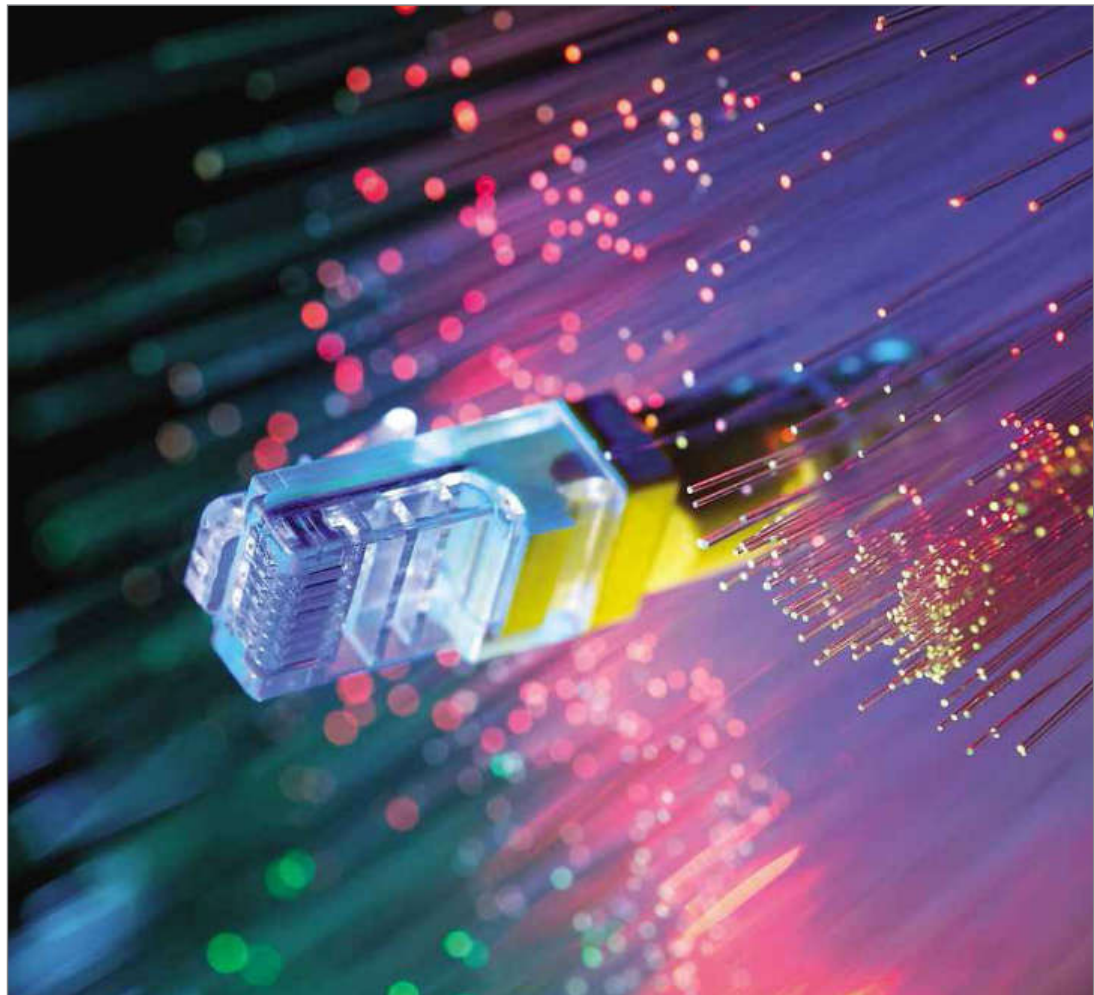
While the government is crowing about hitting its revised target of getting 95% of the UK onto superfast connections by 2017, questions remain about how the final 1.5 million properties will get faster networks. Rural communities continue to suffer from slow broadband and even London MPs complain that key areas of the capital aren't yet up to speed.

Questions are being directed to Broadband Delivery UK (BDUK), the government body tasked with upgrading British infrastructure. All of its grants have been handed to BT, and its practices have been criticised by both the National Audit Office and the Public Accounts Committee of MPs.

Final 5%

Assuming the 2017 goal is hit – and it looks likely – where does that leave the other 5%? Industry experts suggest that BDUK will reveal its plans soon, but it may well wait for the results of a consultation from parliament on that very subject.

“It will be challenging to take fibre coverage beyond 95%, but we're keen to if it's possible,” said Kim Mears, managing director of infrastructure delivery at BT Openreach. “BT's world-class R&D team is working on innovative solutions to connect the final few percent of the UK, and we are already trialling and deploying a range of different technologies to deliver fibre broadband further. That includes fibre-to-the-premises (FTTP), a new form of “fibre to the basement”, fibre-to-the-remote-node (FTTrN) and now our G.fast trials in Huntingdon and Gosforth.” G.fast runs fibre closer to customers' homes, cutting the distance from the cabinet and helping to boost download speeds to as much as 330Mbps/sec.



Andrew Kernahan, public affairs manager for industry body ISPA, highlighted other alternatives, including 4G, satellite and fixed-mobile. “There isn't a one-size-fits-all approach. We're going to have to look at them a bit differently and that's tricky,” Kernahan said. “At the moment, everything should be on the table.”

Andrew Ferguson, editor at Thinkbroadband, said money was the real barrier. “Technical solutions

abound,” he said. “What does not abound, however, is the will from central government, devolved administrations or local authorities to write an open cheque to ensure the final 5% vanishes.”

He pointed out that those who “have grown tired of waiting” have paid for and rolled out their own solutions, such as B4RN, the Broadband for the Rural North project, which is installing its own fibre networks.



Image: BT

■ Futureproofing

On top of such challenges, BT and other infrastructure providers must keep upgrading their existing fibre networks. Indeed, Ferguson said BT's own Fibre to the Cabinet (FTTC) network is more robust than many had feared, after BT crimped its plans to roll out full fibre-to-the-home (FTTH) to 25% of the country.

“BT and other infrastructure providers must keep upgrading their existing fibre networks”

“The BT rollout of FTTC, while heavily criticised – particularly since it scaled back its own FTTH ambitions a couple of years ago – is fairly future-proof, as spare fibre and splitters have reached out to cabinets. If an overriding commercial case were to arise for universal FTTH, then it could be done,” said Ferguson. “For now, BT seems to have not seen an overriding commercial case.” ●

ABOVE Openreach engineer Paul Bardsley surveys for the Superfast West Yorkshire project

Five stories not to miss

1 Firefox boosts Private Browsing

Mozilla has extended existing protections in its Firefox browser's private mode. This means that websites and advertisers will now be blocked from tracking users' activities around the web. At the moment, Private Browsing mode only prevents searches and site visits from being saved after the user has finished browsing, but the new beta will actually enforce Do Not Track (DNT) requests.



2 Facebook M to rival Siri and Cortana

The social networking site is testing its own virtual assistant, which makes restaurant reservations and suggests weekend trips. It manages that using a combination of AI and human employees answering users' questions. So far, it's only being tested in San Francisco.



3 PRS for Music sues SoundCloud

The Performing Rights Society for Music is taking music-streaming site SoundCloud to court, claiming it doesn't have permission to play thousands of tracks that are listed on the site and hasn't been paying royalties to its members. PRS for Music said it had been negotiating with the German music site, but with little success.



4 Sony: don't upgrade to Windows 10 yet

Sony is warning VAIO PC owners to wait to upgrade to Windows 10, as drivers aren't yet ready. If your PC was shipped with Windows 8.1, you'll have to wait until October; if your PC arrived with Windows 8, the update is delayed until November. Windows 7 machines may not get an update at all. Sony sold the VAIO brand in 2013.



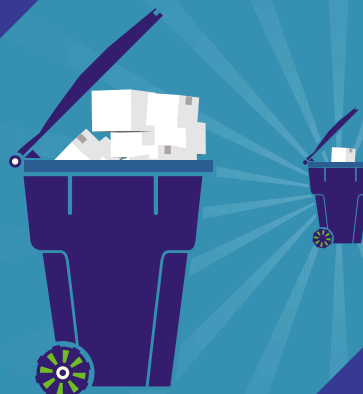
5 Mystery of Windows 10 updates

Microsoft has already released a series of patches for Windows 10, but hasn't actually revealed the contents of any of the updates. The only way to find out if a bug is fixed is to install the patch. This may concern IT managers, especially as updates are now set to install automatically by default.

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Has Microsoft downgraded privacy in Windows 10?

Default privacy settings and new features in Windows 10 have some users worried. **Nicole Kobie** asks the experts if there's genuine cause for concern



IS MICROSOFT TRYING to snoop on users with Windows 10? That's the accusation being levelled at the company by some customers.

For example, Cortana isn't new, but the voice-enabled smart assistant can now use your microphone to eavesdrop and learn your speech patterns. Then there's the diagnostic tool, which can collect more data from crashes, and may even send snippets of your personal files back to Microsoft. That's not to mention the extension of personalised advertising into apps, with Windows 10 studying your behaviour to decide which ads to display.

Finally, there's Wi-Fi Sense, which lets you share your network with anyone in your contact list, without sharing the login details. While that can protect your privacy, it also automatically offers to share your Wi-Fi with everyone in your

contact list – although you do have to approve the connection first.

Has Windows 10 turned Microsoft into the industry's biggest snooper or has it merely brought it in line with rivals who have been hoovering up our data for years? "The industry is changing," said IDC analyst Al Gillen. "The need to access personal information is necessary to be competitive with products from Google and Apple. Interestingly, nobody seems to complain that Siri can read your personal information and use your location.

“Windows 10 is moving forward in ways that are different and likely to make customers unsure”

However, I do agree that Windows 10 is moving forward in ways that are different and likely to make customers unsure.”

■ Sly setup?

Rather than the features themselves, it's the setup procedure that has some concerned. Why aren't these features opt-in? "Oddly enough, it's all opt-in, assuming you don't take the easy route during setup and choose 'Express Settings', which, of course, most people do," said Paul Thurrott, of SuperSite for Windows. "The idea that people are complaining about Microsoft enabling features that they've not taken five minutes to understand or opt out of is amusing."

Indeed, Microsoft explains the new features in detail before you choose whether to use the Express Settings, but Gillen argues that finding the right settings to change after installation is

How to change your settings

Did you take the easy route when installing Windows 10 and opt for Express Settings? Here's how to protect your privacy.

WiFi Sense

You need to give Wi-Fi Sense permission every time you want to share your network connection, but you can turn it off completely by going to Settings | Network & Internet, and clicking "Manage Wi-Fi Settings". Turn off "Connect to networks shared by my contacts". You can also select which contacts to share with.

Cortana

Microsoft's digital assistant collects behavioural and contextual data from your

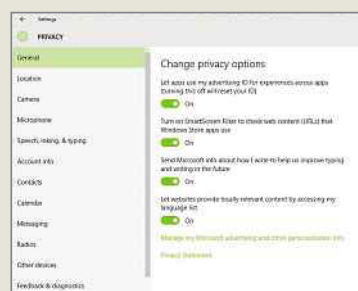
location, contacts, and calendar, and even your microphone. To change the settings, type "Cortana" in the Start menu Search bar to bring up Cortana & Search settings.

Advertising

Turn off personalised advertising in apps by heading to Settings | Privacy. Under General, turn off the selection regarding your "advertising ID". You can also tell Microsoft not to analyse your keystrokes or your language preferences here.

Diagnostics

In the Privacy settings, click Feedback & Diagnostics to change when data is sent, whether



Windows will ask permission first, and what's collected. Unless you're running an Enterprise version, you can't opt to send nothing. Your options are Basic, which sends error reports and essentials such as the version you're running; Enhanced, which includes usage data

such as how long you use a feature; and Full, which can include system files, memory snapshots and snippets of your document data.

The rest

The Privacy section under Settings is worth a few minutes of your time. Here, you can tell Microsoft whether it can track your

location; whether apps can see your calendar, microphone, camera or contacts; how syncing works with other devices, from your Xbox to tracking beacons; and which apps can run in the background, and potentially leak data without you realising.

“difficult”, even for experienced users. Regardless of the setup route, Cortana is opt-in and WiFi Sense is on a connection-by-connection basis: “you have to jump through a few hoops to even use this feature”, according to Thurrott.

However, there is one Windows Update setting he finds “troubling”: “By default, the system will download and upload Windows Updates to other PCs over your home network (which is fine) and over the internet (which is not). This isn’t about privacy, but is more a secrecy and bandwidth issue. People pay a lot for their internet, or have a slow connection, and this option should be disabled by default or opt-in.”

Marketing future

Ads in Windows are also becoming more personal, with behavioural data gathered from the Edge browser and the operating system itself influencing ads in apps. Is this a sign that Microsoft is trying to expand its bottom line with data to pay for the “free” software, like Google? “Some people accept this as part of free software in a services-based economy,” said Gillen. “Others try to fight the trend. If you’re concerned about Cortana, you can use Windows XP forever.”

Thurrott disagrees that data harvesting is Microsoft’s new business model, as Windows 10 is only free for a limited time. In fact, the free-for-a-time upgrade may be why people want to pick holes as, according to Thurrott, “people assume there must be some catch”.

In a statement sent to *PC Pro*, Microsoft said that “Windows 10 puts customers in control by giving them choices about how information is used to deliver personalised services and experiences. We offer customers options in the privacy settings, and they can adjust their Windows 10 settings at any time.” ●

What is... Google’s Alphabet?

Google has a new name – sort of. Here’s why the tech giant has unveiled a new company and what it plans to do with it

Forget self-driving cars and internet balloons, Google’s latest surprise is less about gadgetry and more about business innovation. Co-founders Sergey Brin and Larry Page have unveiled a new company called Alphabet.

Google will become a subsidiary of Alphabet, which will refocus on its core businesses of search and online services, while “moonshot” projects and other tech innovations will be managed by the Alphabet team. Here’s what it means for users and the future of tech.

Can I still use Google as a verb meaning “to search”? Yes, Google isn’t going anywhere. There’s little real change for users: you’ll still Google your searches, check your Gmail, and gaze at Google Maps when lost. However, Google will be wholly owned by a holding company called Alphabet.

What will Alphabet do? Google will still own its ads business, search, Android, maps, apps and YouTube. Alphabet will own Google, as well as smart-home business Nest, its Ventures finance division, its fibre broadband business, Google X Lab and life-sciences research. In other words, the boring bits that make money are now Google, and the self-driving cars, shiny smart-home products and life-extending research are all part of Alphabet.

Seems like a lot of effort. Why reorganise? The split between Google and Alphabet companies should make it easier for the former to focus on making money, while the latter’s projects have more room to innovate. That said, pundits have put forth



a variety of alternative theories, including making the company more appealing to Wall Street, or attempting to better insulate its business from EU regulators, and even trying to hold on to top staff – the more little companies there are, the easier it is to promote people to CEO. Indeed, Google will be run by the former head of Android and Chrome, Sundar Pichai, while Brin and Page will head Alphabet as president and CEO.

Why name a company Alphabet? It must have terrible search-engine optimisation.

Choosing such a common word doesn’t make brand recognition easy, but it’s not really a consumer-facing company, so that shouldn’t be a problem. Plus, Google can simply fiddle its results if it wants Alphabet to rank higher. (Not that the company would do that – or that’s what it tells EU investigators.) That said, the new company will use the domain **abc.xyz**, which is pretty swish.

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IDF 2015: Intel looks beyond laptops

Windows PCs barely got a look in at this year's Intel Developer Forum.

Nicole Kobie reveals why Intel is focusing on the Internet of Things

FROM THE FIRST convertibles to prototype laptops with a transparent chassis, the Intel Developer Forum (IDF) has traditionally showcased the latest computing innovations – and the processors that go inside them. Yet, even with the release of Windows 10 still fresh in the mind, there was little focus on laptops and PCs at this year's IDF in San Francisco.

Instead, Intel's execs couldn't stop talking about the cloud and the Internet of Things (IoT). "I look at all the opportunities, and one thing is clear: computing is everywhere. It's in our bags, our homes, our cars," said Intel CEO Brian Krzanich during his opening keynote speech.

Industry watchers claim that Intel's emphasis on IoT shows it's determined not to miss out on the emerging market in the same way it did with smartphones and tablets. "Unlike mobile where Intel was admittedly late to market, it wants to be ahead of the IoT edge market, and this was the focus of this year's IDF," said Patrick Moorhead, an analyst at Moor Insights & Strategy, referring to the hardware that sits at the "edge" of IoT systems and collects data before sending it over the network.

Intel has already enjoyed success in industrial IoT hardware, such as single-board computers for retail



signs, but it now needs to "prove itself" with its embedded lines, said Moorhead. These include Intel's Quark, a tiny system-on-a-chip, and Edison, a computer the size of an SD card for developing wearables and maker projects.

IoT represents a massive growth opportunity for Intel, with Gartner

ABOVE CEO Brian Krzanich delivers his opening keynote at IDF in San Francisco

predicting that there will be 25 billion connected devices by 2020. "Intel has a much better chance of success in IoT than it did in mobile," said Moorhead. "Unlike in mobility, Intel is ahead of the market, and that will make a huge difference. In a sense, Intel is over-investing in IoT, well ahead of the market and business surge."

Best of IDF 2015

Optane

Intel unveiled its first product based on 3D XPoint, a new non-volatile memory technology that promises vastly improved performance at lower cost (see p129). Optane combines 3D XPoint with Intel's memory

controller and analytics software, with SSDs bearing the Optane brand set for release next year.



Cancer Cloud

Intel's Collaborative Cancer Cloud is a medical project with the Oregon Health & Science University (OHSU), which uses Big Data and analytics to provide personalised treatment for the disease. The aim is to sequence a

patient's DNA in a single day to provide precise treatments for cancer by 2020.

RealSense and Project Tango

Intel's RealSense 3D cameras let users log in to a Windows 10 PC using facial recognition, but the cameras have only appeared in a meagre selection of laptops and tablets so far. Now, Google is using the depth-sensing cameras in its Project Tango handsets, which are the tech giant's take on the smartphone of the future.



Wake on Voice

Windows 10 did get a mention with "Wake on Voice", which lets you say "Cortana, wake up" to your sleeping machine. The feature was first unveiled last year with the launch of the Core M processor, and it now also works with Skylake chips.

Robotic eyes

Intel also showed off RealSense being used as robots' eyes. "Robots have always had eyes, but until now there has never been a cost-effective way of giving them 3D vision," said CEO Brian Krzanich about the Savioke robot, which can navigate its way around a hotel to offer services to guests.





Intel is also performing strongly in the cloud market, another focus of this year's IDF. Gartner analyst Mark Hung called the company's cloud offering the "800lb gorilla in the server market," and Moorhead agreed. "Intel has a market share of over 95% in cloud server processors, so it is killing it," he said – although he noted that the competition "isn't standing still", with ARM making inroads in the server ecosystem. "It will be hard for Intel to maintain its 95% market share, as it is for any company with that much dominance in a market."

Yet, despite the focus on alternative platforms, Intel hasn't yet given up on PCs and laptops, according to Moorhead. PC processors still make up the bulk of Intel's revenue, accounting for well over half of its \$13.2 billion turnover last quarter. Although laptops weren't front and centre, further details about the Skylake processor family were announced at IDF (see p74), and there were dozens of sessions on graphics, security, user interfaces, power consumption and memory architectures, "all of which are centred around the PC or will bring additional value to the PC," said Hung. ●

ABOVE Google's Project Tango handsets will use Intel's RealSense 3D camera

Google OnHub: the router for your smart home

First Nest, then Brillo, and now OnHub – Google makes another play for the Internet of Things

Google's making a renewed bid to take control of tomorrow's smart homes with the launch of its own router.

It's pitching the OnHub – produced by TP-Link – as the router to fix routers. Most routers are ugly, but the OnHub has its dozen antennae tucked inside a sleek chassis, making it more likely to find a home on a shelf than be tucked behind furniture, where its signal might be diminished.

Google's also making the router easy to manage. Rather than logging in to an obscure admin panel, the OnHub can be managed via a mobile app, complete with troubleshooting tools for when the Wi-Fi falls over. Unlike most routers, which don't receive security updates despite being full of vulnerabilities, the OnHub will receive patches automatically.

The real target of Google's OnHub, however, is smart-home appliances. Many connected-home devices come with their own "hub" that sits between the appliance and your router. The OnHub integrates that into the router – as long as your smart-home widget supports Google's Weave, ZigBee, Bluetooth 4 or any of a list of other IoT standards.

OnHub-branded devices are expected to arrive later this year, starting with hardware from Asus. Google says it can support up to 128 devices, and you can choose which ones to favour to ensure your Wi-Fi remains sturdy enough to stream Netflix. The OnHub is available in the US for \$200, with UK availability yet to be confirmed.

This speaker sends an audio tone as a code to your mobile phone for setup

A ring of light shows the router's status using four different colours

Twelve antennae are tucked inside the chassis in a circle for better coverage, with half addressing the 2.4GHz band and the rest on 5GHz, with support for 802.11n and 802.11ac respectively

A reflector is used for the 2.4GHz antennae to help focus the signal and boost range

This vent means fans aren't necessary to keep OnHub cool, despite the dual-core 1.4GHz chip and 4GB of flash storage



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PC Probe

The pirate hunters are back and scary as ever

Received a letter accusing you of piracy? **Adam Banks** reveals the full story behind the latest round of speculative invoicing

What would you do if a letter landed in your mailbox demanding payment for pirating a movie? Thousands of Brits have faced this decision after Sky handed over subscriber details to the rights-owner of a little-seen Robert Redford film.

Long-term *PC Pro* readers will remember Davenport Lyons and ACS Law, a pair of law firms that sent similar letters demanding up to £750 for sharing games and pornography on torrent sites several years ago. Next came Golden Eye International Limited, headed by porn star Simon Honey, also known as Ben Dover.

Like the most recent round of letters, they used a tracing company to uncover IP addresses that had shared particular files, then applied for a Norwich Pharmacal court order to force ISPs to disclose which subscribers they belonged to.

Those letter campaigns, characterised as “speculative invoicing” and referred to as “blackmail” in a House of Lords debate, resulted in ACS Law’s Andrew Crossley and two partners at Davenport Lyons being suspended and fined. Speculative invoicing seemed extinct, but it was merely evolving.

■ Evolution of speculative invoicing

In January 2015, a court order was obtained against Sky by a company named TCYK LLC, represented by solicitors Wagner & Co. TCYK had bought the rights to the Robert Redford film *The Company You Keep*.

After getting the names and addresses of suspected pirates from Sky, TCYK wrote to them in July. The letterhead refers to a Nevada corporation, TCYK LLC. The return address, however, is 43

Berkeley Square, London W1. The natural assumption is that the letters came from Wagner & Co, but *PC Pro* has established this to be untrue. Wagner & Co is owned by Mark Wagner, a long-serving solicitor and part-time judge working from home in a north London suburb, far from 43 Berkeley Square. “I think there’s a common misconception about this,” he told us as soon as we mentioned TCYK LLC. “I’m not taking action against anyone. I know what Davenport Lyons and ACS Law did – I don’t do that.”

Wagner’s job is purely to apply for the Norwich Pharmacal order. “Once any order is obtained, I will send it to the ISP and liaise with them to obtain disclosure of the names and addresses, as ordered by the Court,” he said. “This is the end of my involvement.”

■ Who’s involved?

Who is sending the letters then? The applicant against Sky undertook that it would not remove any personal

data “from the jurisdiction of this Court”. But TCYK isn’t within the jurisdiction of the court. Despite the Nevada letterhead, Mark Wagner told us his client was “TCYK LLC, incorporated in California”. The California state department lists The Company You Keep Productions, Inc, represented by the lengthily named law firm Jackoway Tyerman

Wertheimer Austen Mandelbaum Morris & Klein, which celebrity sites confirm as being Robert Redford’s lawyers.

Neither TCYK is registered with the US/EU “Safe Harbor” scheme that permits personal data to be transferred abroad, although there is a derogation in the Data Protection Act for the purposes of legal proceedings.

Sky wouldn’t offer any further information about where the data was delivered, but stressed it was handled with due care as instructed by the court.

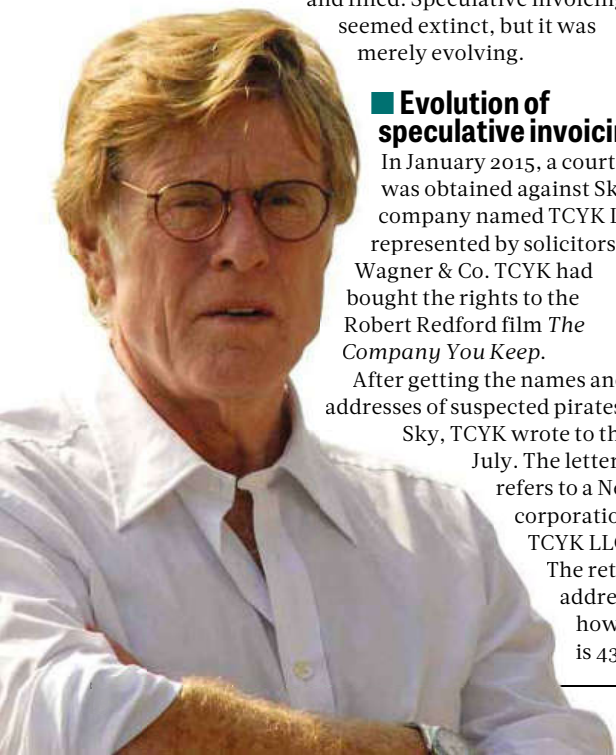
What of 43 Berkeley Square? The address is used by a large number of companies. One of them, Hatton & Berkeley, posted in July 2015 that it was “proud to be spearheading the UK’s largest anti-piracy campaign ever, in partnership with **maverickeye.de**”.

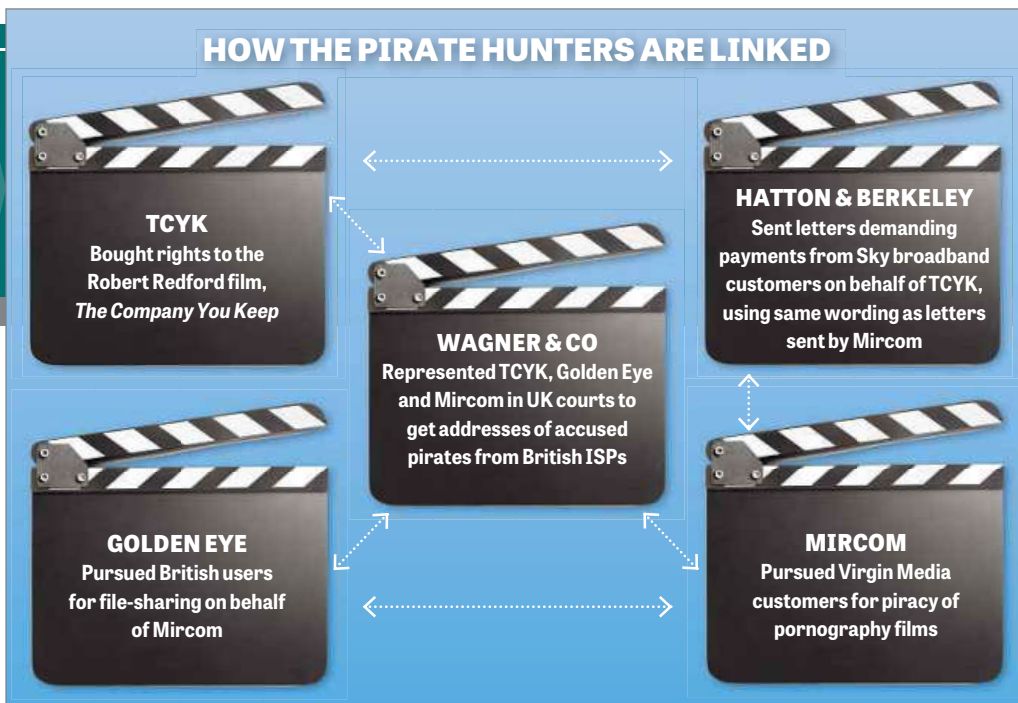
Maverick Eye is a German IP-tracing company that seems very similar to others, also based in Germany, used by ACS Law and Davenport Lyons.

“After getting the names and addresses of suspected pirates from Sky, TCYK wrote to them in July”

LEFT The letters centred on piracy of a 2012 Robert Redford film

Image: Shutterstock





Its expert, Daniel Macek, appeared in court in Australia earlier this year for the rights-holders of *Dallas Buyers Club*.

Hatton & Berkeley, meanwhile, is a trading name recently adopted by CMI Business Group Ltd. An anti-piracy blurb on its website is linked from an image of the poster for *The Company You Keep*. Its Dispatch division at Hatton Garden appears to be a mailroom, and CMI Business Group Ltd is registered as a data controller.

It would seem entirely within its remit to post a letter prepared by an American client to a list of names and addresses, and process the replies. Why, then, when *PC Pro* phoned to follow up its online press release, did its operations manager promise to call back, not call back and later apologetically insist "we are not saying anything to the press right now"?

Taking a step back

We need to rewind to October 2014, when an order was obtained against Virgin Media by Mircom International Content Management & Consulting Limited (MCM), represented by Wagner & Co. Mircom accused subscribers of file-sharing its clients' films, including *Sexy Brazilian Lesbian Workout*.

Mircom is based in Cyprus, but its reply address is Winston House, 2 Dollis Park, Finchley, London N3. This faded office block is associated with some 392 companies, though neither Mircom or MCM is listed as a tenant, and no such company is registered in the UK. We can only guess who might be sending the Mircom letters, but there's a clue when users reply. Follow-up letters begin: "We, Golden Eye International Ltd (GEIL) have been given the right by Mircom to pursue infringement of their copyright..."

Nothing links TCYK or Hatton & Berkeley to pornography trolls Mircom and Golden Eye. Except that both Mircom and TCYK were represented by Mark Wagner, who also represented

BELOW *PC Pro* investigated the ACS Law case back in 2011

opportunistic threats can still continue.

Should you pay?

However, that doesn't mean that you should pay if you get a letter. Michael Coyle at Lawdit Solicitors has had a lot of experience with these cases after volunteering to represent users accused by these letters in return for a donation to charity (virginmoneygiving.com/michaelcoyle). Having dealt with a number of Mircom cases in 2014, he's been approached by hundreds of TCYK recipients.

"It's a huge racket," he told *PC Pro*, noting that as soon as users reply, the response is to demand £600. "The data is years old – and defendants are saying 'We didn't even live here then'," he said. Although he advises caution, Coyle said the chances of any user being sued are slim. "I'd be amazed," he said, suggesting that law firms "wouldn't touch it" from the complainant's side. ●





The A-List

The ultimate guide to the very best products on the market today

LAPTOPS

Apple MacBook Pro 13in with Retina display

2015 model, from £999

apple.com/uk

With its innovative Force Touch trackpad, Broadwell processors and the same excellent Retina screen, the MacBook Pro is better than ever. It's fast, with superior battery life to the previous generation, and that trackpad adds to all-round usability.

REVIEW: pcpro.link/almacp15



SMARTPHONES

Samsung Galaxy S6

Android, 32GB, free phone, £26/mth, 24mths

omio.com

With the Galaxy S6, Samsung has finally created a phone as beautiful as it is capable. Superb performance, a nigh on perfect display and an astonishingly good camera provide the perfect foil to the most attractive Samsung handset yet.

REVIEW: pcpro.link/algals6



ALTERNATIVES

Lenovo IdeaPad Yoga 2

A versatile hybrid laptop with the best IPS screen in its class – now available at an irresistible price. **£300;** argos.co.uk **REVIEW:** pcpro.link/alyoga2

Asus Zenbook UX303LA

The latest Broadwell Core i7 and a quality screen make this Ultrabook both desirable and great value. **£734;** handtec.co.uk **REVIEW:** pcpro.link/alzb303

HP Stream 11

Good-looking, well built and equipped with a decent display, the petite Stream 11 is as good as it gets for the money. **£180;** hp.co.uk **REVIEW:** pcpro.link/alhp11

ALTERNATIVES

Motorola Moto G (3rd gen)

NEW ENTRY
The budget smartphone gets a smart new look and an updated camera. **SIM-free, £159;** motorola.co.uk **REVIEW:** see p64

Sony Xperia Z3 Compact

Speedy performance, decent battery life and a fine camera – all for a great price. **From free, £22/mth, 24mths;** omio.com **REVIEW:** pcpro.link/alsonyZ3

Apple iPhone 6

Apple steps up to a larger screen size with the classy, long-lasting 4.7in iPhone – but it's pricey. **64GB, from free, £39/mth, 24mths;** omio.com **REVIEW:** pcpro.link/alip6

TABLETS

Apple iPad Air 2

9.7in tablet, 64GB, £479

apple.com/uk

Even faster, even lighter and just as pretty as ever – the iPad Air 2 takes everything that made the original great and improves upon it. Updated cameras and the arrival of Touch ID are welcome upgrades. Its only real rival is the original 32GB iPad Air, now discounted to a tempting £359.

REVIEW: pcpro.link/alipair



ALTERNATIVES

Tesco Hudl 2

Tesco's budget Android tablet sports a high-quality 8.4in IPS display and great design. You can't top it for value. **£99;** tesco.com **REVIEW:** pcpro.link/alhudl2

Linx 8

Part of a new wave of ultra-affordable compact Windows tablets, the Linx 8 squeezes in plenty for the price. **£100;** pcworld.co.uk **REVIEW:** pcpro.link/allinx8

Sony Xperia Z2 Tablet

The most desirable full-sized Android tablet yet, thanks to great design and battery life. **16GB, £330;** johnlewis.co.uk **REVIEW:** pcpro.link/alxz2tab

PCs

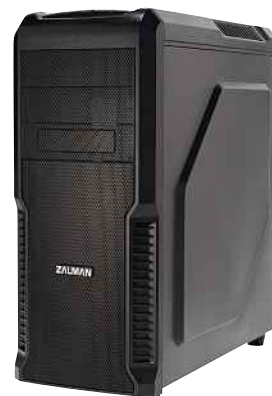
Chillblast Fusion Quasar

Base unit, £630

chillblast.com

Chillblast's Fusion Quasar is the very definition of a classy all-round base unit. A Core i5 CPU overclocked to 4.3GHz delivers plenty of raw power, combined with good gaming capability and serious upgrade potential. A five-year warranty seals the deal.

REVIEW: pcpro.link/alchill



ALTERNATIVES

Apple iMac 21.5in

A classy all-in-one with a compact frame, ample power and a colour-accurate screen. **From £899;** apple.com/uk **REVIEW:** pcpro.link/alimac215

Apple iMac 27in with Retina 5K display

Astonishing image quality and stunning resolution: a great PC. **From £1,599;** apple.com/uk **REVIEW:** pcpro.link/alimac275k

Acer Revo One RL85

An elegant, versatile compact PC with great expansion options and a competitive price. **From £400;** currys.co.uk **REVIEW:** pcpro.link/alacerrevo

MONITORS

Asus PB287Q

Premium monitor, £405
ebuyer.com

Not so long ago, a 4K display for less than £500 was unimaginable. Asus delivers exactly that: a razor-sharp image on a 28in panel at a very reasonable price.

REVIEW: pcpro.link/alpb287q



Eizo ColorEdge CS240

Eizo ticks almost every box with the 24.1in, 1,920 x 1,200 ColorEdge CS240. With a highly colour-accurate IPS screen, it's the first truly professional-class monitor we've seen at anywhere near this price.

£462; wexphotographic.com

REVIEW: pcpro.link/alcs240

AOC q2770Pqu

A feature-packed, 27in 2,560 x 1,440 display offering a huge workspace, an adjustable stand, a four-port USB hub – and a three-year warranty. Super PLS technology gives great viewing angles too. At this price, it's a steal.

£330; overclockers.co.uk

REVIEW: pcpro.link/alq2770

PRINTERS

Canon Pixma MG6450

All-in-one inkjet printer, £99
wexphotographic.com

The MG6450 inherits its predecessor's status as *PC Pro*'s favourite inkjet all-in-one, offering high-quality output at a very reasonable price.

REVIEW: pcpro.link/almg6450



Canon Pixma iP8750

Canon's mid-range inkjet is ideal for anyone with a fancy for prints larger than the usual A4. It can print photos at up to A3+ in size, and its six-ink cartridges produce immaculate photographs, yet the price is very reasonable.

£219; parkcameras.com

REVIEW: pcpro.link/alip8750

Epson Expression Photo XP-950

Epson's high-end inkjet all-in-one is a fantastic all-rounder for the enthusiast photographer. It combines high-quality prints with a decent scanner, a great touch interface and the ability to output photos at up to A3 in size.

£180; currys.co.uk

REVIEW: pcpro.link/alxp950

ROUTERS

Netgear R7500 Nighthawk X4

AC2350 router, £170
broadbandbuyer.co.uk

Top Wi-Fi performance close-up and at long range, swift USB NAS performance and all the latest Wi-Fi goodies make the Nighthawk our Wi-Fi router of choice.

REVIEW: pcpro.link/alr7500



D-Link DIR-868L

This 802.11ac wireless router may not have the most impressive set of features, and it lacks an internal modem. However, in our tests it outpaced models costing twice as much, making it an affordable way to get speedy wireless performance.

£92; ebuyer.com

REVIEW: pcpro.link/aldir868l

Netgear Nighthawk AC1900 Extender

The most powerful wireless extender on the market, Netgear's Nighthawk marries five Gigabit networking ports with fast, dual-band 802.11ac support and a host of features.

£130; broadbandbuyer.co.uk

REVIEW: pcpro.link/alngex7000

HOME NETWORKING

Synology DiskStation DS215+

Network-attached storage, £258
amazon.co.uk **NEW ENTRY**

A versatile dual-bay NAS with great support for cloud services, dual USB 3 ports and our favourite web-based management interface. It's speedy and packs a lot into a compact unit.

REVIEW: pcpro.link/alds215plus



Qnap TS-453mini

NEW ENTRY
Superb performance and a decent range of media and server features – including an HDMI output – make this four-bay NAS drive a great choice for both home and business.

£435; ebuyer.co.uk

REVIEW: pcpro.link/alts453mini

Google Chromecast

This is the future of TV streaming – cheap to buy and simple to use. Plug the Chromecast into a spare HDMI port at the back of your TV, then browse on your smartphone or tablet and beam Full HD content directly onto the big screen.

£30; play.google.com

REVIEW: pcpro.link/alccast

WEARABLES

LG Watch Urbane

Smartwatch, £224
amazon.co.uk **NEW ENTRY**

The best Android smartwatch out there, with a genuinely stylish design – including a proper leather strap – a bright circular OLED display and a 60-hour battery life. It's a great all-round package.

REVIEW: [see p83](#)



Apple Watch Sport

NEW ENTRY
The slickest smartwatch experience there is, thanks partly to the unique scroll-wheel interface and advanced haptic features. The weakness is battery life – expect to charge it every night – and even the low-end Sport model is a pricey proposition. **£299, apple.com/uk** **REVIEW:** [see p82](#)

Pebble Time

NEW ENTRY
A fun, practical watch that works with both Android and iOS. App support is comparatively limited, but all the fundamentals are covered, and the colour e-paper screen helps the Time achieve five days of battery life. **£180, firebox.com** **REVIEW:** [see p89](#)

SECURITY SOFTWARE

Kaspersky Internet Security 2015

Another year, another excellent performance for this super-secure, lightweight and unintrusive security suite.

3 PCs/1yr, £25; store.pcpro.co.uk

REVIEW: pcpro.link/alkasis15



Avast Free Antivirus

Still the best free antivirus, although others are catching up. It offers dependable protection – and it doesn't nag you about upgrading. **Free;**

avast.com

REVIEW: pcpro.link/alavast15

Norton Security 2015

A venerable name in security, Norton provides excellent protection and covers up to five devices, including laptops, tablets and smartphones.

5 devices/1yr, £25; amazon.co.uk

REVIEW: pcpro.link/alnort15

PRODUCTIVITY SOFTWARE

Microsoft Office 2013

Microsoft retains the top spot for the ultimate office suite, although tablet users may be disappointed by lacklustre touch support.

From £110; office.microsoft.com

REVIEW: pcpro.link/aloffice13



LibreOffice 5

NEW ENTRY

The interface looks a little dated, and the lack of collaboration features is a shame. But interoperability with Word and Excel is better than ever, making this a fine upgrade.

Free; libreoffice.org

REVIEW: see p70

Scrivener

A brilliant package for serious writers: not just a word processor, but a tool that helps you organise your ideas and manage the process of composition from start to finish. **£29;**

literatureandlatte.com

REVIEW: pcpro.link/alscrivener

CREATIVITY SOFTWARE

Adobe Creative Cloud

The licensing model won't suit everyone, but Adobe's suite of creative tools keeps getting better, covering everything from photo and video editing to web development.

Complete plan, £46/mth; adobe.com

REVIEW: pcpro.link/alcc15



Adobe Photoshop Elements 13

Adobe's home image-editing tool is a terrific and powerful buy, although users of older versions won't find much reason to upgrade.

£68; amazon.co.uk

REVIEW: pcpro.link/alelements13

Steinberg Cubase Pro 8

A big bump in performance and a handful of UI improvements keep Cubase at the top of the audio-production tree. A worthwhile upgrade.

£362; dv247.com

REVIEW: pcpro.link/alcubasepro8

SERVERS

HP ProLiant DL80 Gen9

Massive storage capacity combines with a high-speed Xeon E5-2600 v3 CPU and a scalable design to push this HP rack server to the top of the tree. The price is very reasonable as well. **£1,026 exc VAT; insight.com**

REVIEW: pcpro.link/alhpdli80



HP ProLiant ML150 Gen9

HP's compact tower server packs in a huge range of high-end features, alongside impressive expansion capabilities so it can grow as your business does. **£913 exc VAT; insight.com**

REVIEW: pcpro.link/alhplml150

STORAGE APPLIANCES

Qnap TS-EC880 Pro

Qnap's eight-bay desktop NAS sets new standards in the desktop NAS appliance space, combining ultra-powerful hardware with every storage feature you could wish for. It has huge expansion potential, and 10GbE networking seals the deal. **Diskless, £989 exc VAT; ballicom.co.uk**

REVIEW: pcpro.link/alcec880pro



Synology RackStation RS2414RP+

Built with speed and expansion in mind, this 2U rack NAS offers a feast of storage features and plenty of expansion potential. It's good value, too.

Diskless, £1,234 exc VAT; ballicom.co.uk

REVIEW: pcpro.link/alrs2414rp

SECURITY

Sophos SG 115w

A security appliance that gets it right on almost every level. Easy deployment, a huge range of features and a tempting price make this the perfect choice for SMBs. **With 1yr FullGuard, £809 exc VAT; sophos.com**

REVIEW: pcpro.link/alsophossq



Sophos Cloud

User-based policies and slick mobile support make this a top-class cloud solution. Performance is impressive, too. It's not the cheapest option, but it's a pleasure to use. **10 users, £510/yr exc VAT; sophos.com**

REVIEW: pcpro.link/alscloud

BUSINESS PRINTERS

Epson WorkForce Pro WF-5620DWF

Shatters the myth that inkjets are only for low-demand use, delivering fast output speeds, low running costs and tons of features.

It prints at 20 pages per minute, and quality is perfectly acceptable – it can even print glossy photos. **£187 exc VAT; printerland.co.uk**

REVIEW: pcpro.link/alwf5620

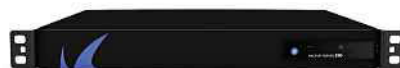


BACKUP

Barracuda Backup Server 290

A beautifully simple appliance that brings together on-site and cloud backup. There's block-level deduplication, extensive support for Windows systems and applications, integral Exchange MLB, and simple deployment and management. **£4,446 exc VAT; barracuda.com**

REVIEW: pcpro.link/alserver290



DataFort Critical Care

DataFort's managed backup service takes care of everything, even bringing up virtual clones of your systems should disaster strike. Per-server pricing makes it cost-effective too. **One server, £350/mth exc VAT; datafort.com**

REVIEW: pcpro.link/aldatafort

NETWORK MANAGEMENT

Paessler PRTG Network Monitor 15

A network-management solution that's ideal for businesses on a tight budget. Supports a wide range of devices, which are included in the price, and licensing is based purely on sensor count, so there are no hidden costs. An excellent way to keep tabs on what's going on in your network.

500 sensors, 1yr, £1,055 exc VAT; paessler.com

REVIEW: pcpro.link/alprtgt15



SolarWinds Orion NPM 11.5

Offers excellent value for money, packing in a huge number of monitoring features as standard, including support for 802.11 wireless access points and virtual machines. **250 elements, £4,110 exc VAT; solarwinds.com**

REVIEW: pcpro.link/alnpm115

HP Color LaserJet Enterprise M553x

NEW ENTRY

An A4 colour laser offering excellent quality, fast 38ppm printing and a low-power fuser that slashes the time to first page. The 10.9in touchscreen is a delight to use too. **£648 exc VAT; printerland.co.uk**

REVIEW: see p98



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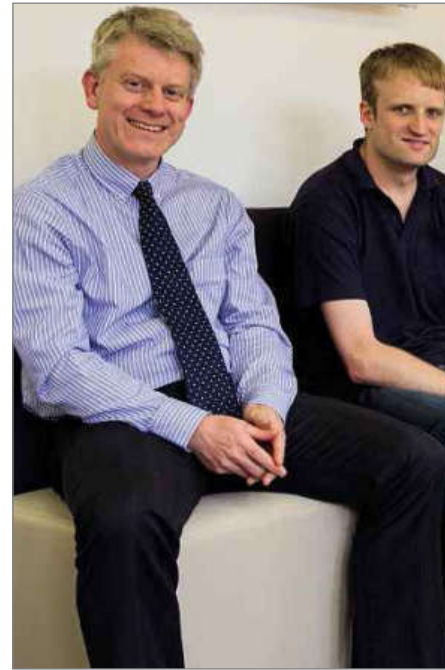


Profile

BACKGROUND INFO ON INNOVATIVE BRITISH COMPANIES

TransportAPI

We meet the public-transport data firm that always knows whether the trains are running on time and even where the free seats on your bus are



KEY FACTS

IN A NUTSHELL

TransportAPI creates and collates open data about Britain's transport networks and sells it to app developers, airports and retailers. It currently distributes its data to more than 1,400 developers and organisations.

FOUNDED 2010

STAFF 10

LOCATION London

WEBSITE
transportapi.com

The number 14 bus gets stuck in traffic on the Fulham Road for 20 minutes, arriving later than anticipated at South Kensington Tube station. Just as you're getting off the bus, the Citymapper app alerts you that the District line has been suspended between Earl's Court and Embankment, meaning you'll almost certainly miss your train from Victoria. The app directs you up the Piccadilly line to Green Park and back down to Victoria, where you can catch the next train – if you hurry.

Feeding all this information to you from one app is no small feat of software engineering. It requires accurate real-time data from at least three sources (bus, Tube and train), all of which use different formats, location IDs and semantics. Enter TransportAPI, a five-year-old British company that is the only single source of public transport data in the UK. Whether you're leaping onto a bus in Bristol or catching a cab in Canary Wharf, TransportAPI aggregates, harmonises and distributes the data, meaning you'll know when you'll reach your destination and how much it will cost.

TransportAPI is already a source of valuable data for travellers, but wants to do more. Where are the empty seats on the top deck of the bus? Is it cheaper to hire a car and drive to Manchester or take the train? TransportAPI wants to make your apps – either as a consumer or a developer – much more informative.

■ Making the most of open data

It only takes a glance at the Tube map to realise that running a transport system is a complicated business. The morass of real-time data produced by the country's various transport systems is even more byzantine, which is why academics Jonathan Raper and David Mountain decided someone needed to make sense of it all.

In 2010, they set up TransportAPI, with the aim of knitting together of all the real-time data from the various transport companies. "A lot of open data is not well documented," Jonathan Raper, co-founder and managing director of TransportAPI, told *PC Pro*. "We specialise in trying to understand the syntax and semantics of it."

"A lot of the digital infrastructure around those services is relatively poor," added Raper. "You may have all the sensor data you can shake a stick at, but the references that tell you where those sensors are located are not in as good shape. So we maintain a lot of infrastructure data,

reference lists and lookup tables of different identifiers that are used by different services."

A key part of TransportAPI's job is marrying overlapping data from different sources. For example, bus and Tube services may serve the same location, but the two data feeds will use different identifiers for the same stop. TransportAPI pulls this information together so partner app providers such as Citymapper don't have to. "We do a lot of harmonisation, error checking, validation and organisation," said Raper.

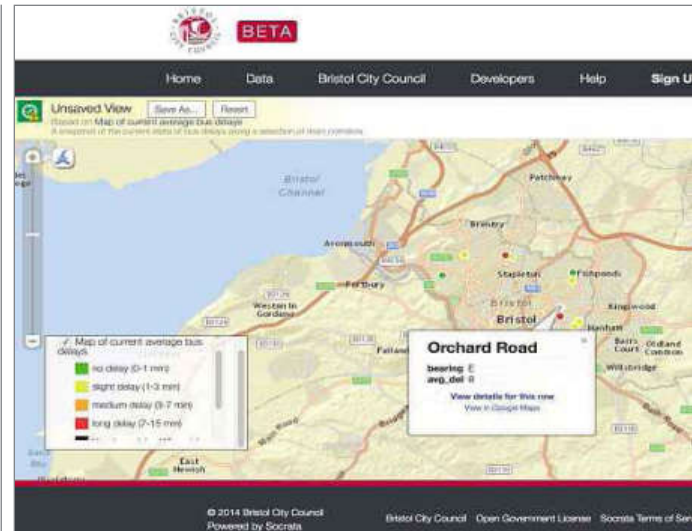
The journey-planner app makers could get all this information for themselves – often for free – but they would rather pay TransportAPI to provide all that data in one go. "We can aggregate," said Raper, "which means developers don't need to sign agreements with lots of different data providers and try to make sense of the different formats. In our service, once you've used one interface, you can use it in every transport area. If you build a bus app and then decide to add trains, all you have to do is change the URL to '/train'."

Raper claims that making sense of the various transport companies' data is the biggest technical challenge his team faces. The company maintains databases based on "some very complex and difficult-to-handle data formats such as TransXChange, which is the representation of transport timetables. It has exceptionally difficult semantics associated with it. One of the dev team quipped that it's so sophisticated it's capable of encoding interplanetary travel timetables as well as the number 46 bus."

Transport companies even sabotage data to stop the public or their rivals having access to it. "There are situations where things are deliberately obfuscated," said Raper, accusing some transport operators of trying to protect their monopolies. "It's a weapon, an example of a 21st-century digital competition tool for large organisations – to try and make their data very difficult to consume. There may be regulatory reasons why they're being forced to release it, but there are operational reasons why they don't want other people to see what they're doing and how they're doing it."

■ Keeping it real-time

It's critical that the data provided by TransportAPI to app developers is both fast and reliable. Harassed commuters won't tolerate error messages or inaccurate



LEFT Founded in 2010, TransportAPI aggregates data from a range of public transport services across the UK

ABOVE Bus routes are colour-coded, depending on the length of delay, allowing users to adapt and change their journeys



ABOVE The Transport Buzz feature displays a map of transport-related tweets

data any more than they would the cancellation of their train home.

Raper admits that, while you would expect 99.99% reliability from an infrastructure-as-a-service provider like Amazon or Microsoft Azure, you can't expect high figures from data-as-a-service hosts. Why? "There are outages on the sensor networks that feed in and you can't control that," not to mention connections with other services "that sometimes get stressed". He cited the recent Tube strikes as a time when data feeds are under enormous strain, and TransportAPI uses auto-scaling technology with its cloud providers to help ensure information keeps flowing to travellers during data rush hours.

The company also does a lot of internal and external monitoring of its systems. Raper said the firm is constantly checking the performance of the Apache server and its Ruby on Rails application, and uses Pingdom to check how the services look to TransportAPI's customers. "We do monitor the service pretty obsessively," admitted Raper.

The company publishes its uptime metrics and is very upfront if there are problems with the feeds. "Ultimately, confidence in our service comes from trust," he said. "If you're on fire but you don't tell anybody, and you don't tell them afterwards either, people worry. You just can't afford that."

More detailed data

Transport data may not be a sexy topic of conversation, but the forthcoming projects TransportAPI is developing with its partners are genuinely innovative. One partner is

installing Bluetooth counters at bus stops to estimate how many people are waiting at the stop. (An app that tells you how many people are in the bus queue in front of you – is there anything more quintessentially British?) Then there's the prototype cameras that have been installed on two of London's double-decker buses, which use face tracking to tell customers on the lower deck how many seats are available upstairs, with the precise location of the free seats shown on an LCD display at the bottom of the stairwell.

The company also has ambitions beyond traditional forms of public transport. TransportAPI is working with a company called Taxicode (taxicode.com) to provide a price-comparison site for cab journeys, allowing users to enter a pickup point and destination to see the range of prices on offer from different firms, and types of vehicle. The company is also in talks with car hire firms and car clubs to merge their data with public transport prices, so that travellers can work out if it's cheaper to jump behind the wheel for all or part of a journey.

However, TransportAPI's most disruptive plans concern the rail network and creating a data-mineable

source of British rail fares. Raper claims online ticket sellers such as thetrainline.com aren't allowed to data-mine the fare information provided by different train operators. TransportAPI will use open data about rail fares to build a database that can answer queries like "can I get a ticket that costs half the price for three times the journey

time?" or "what's the most scenic route between A and B?"

"We're enabling people to find the answers to those sort of questions, and we think we can find new markets," said Raper. Handing public transport data back to the public?

Now that sounds like a "fare" deal. **BARRY COLLINS**

What about you?

Do you work for a British technology company that could be profiled in PC Pro? If so, get in touch: profile@pcpro.co.uk



Viewpoints

PC Pro readers and experts give their views on the world of technology

New memory tech is a bigger deal than next-gen CPUs

Superfast and abundant local storage would be a game changer if it became a reality



Darien Graham-Smith is PC Pro's deputy editor, a job that often makes him wish for a new memory technology of his own

Christmas, birthdays and the Intel Developer Forum (IDF) – the landmark dates in my calendar. One thing that makes IDF an almost unique industry event is its lack of spin: Intel engineers speak with remarkable candour about the projects they're working on, and even research that's still years

away from appearing in a product.

More than that, IDF also tends to be where you first hear about the new technologies that go on to set the pace for the whole industry. It was at IDF that I encountered the very first Core i7, and where the original Silverthorne Atom processor ushered in the age of the netbook. At IDF 2011 Intel publicly unveiled the Haswell architecture for the first time – a full two years before the chips went on sale – while the 2013 Forum introduced Bay Trail, the first Atom architecture you might actually want to use.

It's not just about processors either.

IDF was where I first saw Light Peak, the high-speed interconnect that became Thunderbolt, as well as the 3D RealSense camera system, which brings *Minority Report*-style interfaces into

reality. There's even a decent line in entertainment: at various IDF events I've seen USB 3, DDR4 and Maroon 5.

So I'm a bit rueful to have missed IDF this time around – even if it was for the pretty good reason of having a pregnant wife at home to look after. This year's event saw one of Intel's most revolutionary announcements in years: co-developed with semiconductor giant Micron, 3D XPoint memory is a new type of memory cell that takes the form of a three-dimensional mesh of criss-crossing electrical elements. Intel claims that the new design offers ten times the density of today's DRAM, while also being cheaper, non-volatile and a thousand times faster than current flash memory.

If all that's true then 3D XPoint – under the brand name "Optane" – could change the way we design computers. For 70 years, we've been combining fast, volatile RAM with slower, non-volatile mass storage. Although both do the same basic job, we've had to implement them as separate components to achieve a workable balance between price, performance and permanence. If XPoint really is cheap, fast and non-volatile, it can replace both, massively simplifying future technology designs.

“Right now, my NAS drive is nudging 4TB of data, but yes, if I'm honest, I do want to carry all those files around with me”

Before we get too excited about that prospect, several words of caution. For a start, Intel hasn't yet provided any solid performance figures, and there's some suspicion that its claims of huge speed improvements over regular flash might focus on latency rather than sustained bandwidth. It's suggestive that, as we note in our Futures section on p129, the company isn't currently touting XPoint as a replacement for DRAM, but rather as a sort of general-purpose cache.

Then there's the hard-nosed question of whether combining the DRAM and SSD into one module would really make much difference to the end user. Removing a single controller from a chipset is going to knock at most a few quid off the cost, and it won't save much power, either:

a typical SSD draws about 2W, so (based on a 47Wh battery) even ditching it completely will probably only reduce your overall power draw by around 4%. If we want to make a significant difference to battery life, we need to target screens rather than storage.

All the same, if this is a new push for more and faster storage, I'm happy. With CPUs, even the cheapest model is fine for everyday use nowadays. The same certainly can't be said for storage: the low-cost laptops that are becoming the norm still come with as little as 16GB of flash memory, and the same goes for phones and tablets. That's the same amount that came with the original Asus Eee PC 900, which was released back in 2008. It's crazy.

In fact, between you and me, I can't help but suspect that someone has been encouraging laptop manufacturers to keep their local storage offerings as lean as possible so as to push users towards a certain cloud-storage service. The idea that customers would willingly choose the very slowest medium available as a central repository for all their files is absurd. The sensible way round would be to ensure that all our devices provide enough storage for us to keep a copy of everything locally on each one, and to use the cloud to keep everything synchronised in the background.

Perhaps I'm asking for the moon on a memory stick. Right now, my NAS drive is nudging 4TB of data, but yes, if I'm honest, I do want to carry all those files around with me. Yes, I want the spreadsheets from issue 188, and the holiday photos from 2011. I want copies not only on my desktop PC, but on my laptop, tablet, phone

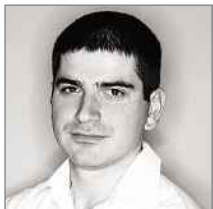
and watch as well. And I want them because, well, why not? When I think back over my years of attending IDF, I'm reminded of how the most unreasonable-sounding fantasies can turn into mainstream reality with surprising rapidity.

Even if the arrival of 3D XPoint doesn't directly deliver that sort of storage revolution, it serves as a useful reminder to us techie types not to get too cocky. As a former IT support agent, I've long grown accustomed to users telling me that their PC has "120GB of RAM", or that they've downloaded a big file and now their computer has "run out of memory". The next time I hear a similar claim, I'll stifle my habitual snort of disdain; it may be that they have a better grasp than I do of how things ought to work.

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If only Amazon treated its staff like it treats its customers

Next-day deliveries at seductive prices don't excuse treating your employees like serfs



Barry Collins is a former editor of PC Pro, but can't quite bring himself to be a former customer of Amazon

It's late Sunday evening, and I'm reading on the sofa when there's a knock at the door. It's one of those "who can that be at this time?" moments: you start mentally forming a shortlist as you go to answer. Could it be a neighbour in bother? The police? No – it's an Amazon courier. "Sorry to disturb you so late," he says sheepishly, handing over a package I'd ordered just the day before. "I'm, erm, running behind."

I can well believe it. Because the article he interrupted me reading was, I kid you not, a feature in *The New York Times* detailing the brutally long hours Amazon staff are expected to work.

More than any tech company I can think of, Amazon pricks my conscience. I love that a delivery driver will knock on my door with a parcel at 9pm on a Sunday, and I hate it at the same time. How many people are pulling all-nighters just so I can receive my parcel within the 24 hours that Amazon Prime promises, even on a weekend? Is it really necessary?

Jeff Bezos thinks so. The Amazon boss tells his staff to walk over coals for customers. According to Brad Stone's book, *The Everything Store: Jeff Bezos and the Age of Amazon*, "if one customer has a bad experience, Bezos often assumes it reflects a larger problem, and escalates the resolution of the matter inside his company with a question mark."

What happens to the poor souls on the end of these single-character missives? The eye-opening *New York Times* piece revealed that it wasn't only Christmas temps in the warehouse getting the rough end of the stick

from Amazon, but staff throughout the entire organisation. If the article is an accurate reflection of life within Bezos' business, we're looking at a company in which people aren't only pushed to their limits, but well beyond them.

It's claimed that employees routinely receive emails after midnight – shortly followed by a text message to chase them up if they haven't responded. A mother of three was reportedly told by her boss that "raising children would likely prevent her from success at a higher level, because of the long hours required." An employee who had miscarried twins was sent on an Amazon business trip just days later: "I'm sorry," her manager told her, "the work is still going to need to get done."

Following the publication of the *New York Times* story, Bezos sent an open letter to staff, declaring that the article "doesn't describe the Amazon I know." He said the article gave the false impression that Amazon's "intentional approach is to create a soulless, dystopian workplace where no fun is had and no laughter heard" and subsequently urged employees to report any abuses to the HR department, or to him directly. "Even if it's rare or isolated, our tolerance for any such lack of empathy needs to be zero," he wrote.

Maybe such cases are isolated – maybe not. On the recruitment site glassdoor.com, Amazon scores a reasonable 3.4 out of 5 from current and former employees. But dig deeper and you'll soon find hundreds of reviews attesting that the company offers "absolutely no work/life balance". For example, the *New York Times* cited one manager claiming to regularly work 85 hours a week. And that's a culture that seems to come from the top: "It's not easy to work here," Jeff Bezos wrote in a 1997 letter to shareholders. "When I interview people, I tell them 'you can work long, hard or smart, but at amazon.com you can't choose two out of three'." He may publicly condemn abuses, but with statements like that on the record, does he really expect staff to come to him with their concerns over gruelling hours?

The Amazon ethos leaves me conflicted. Its customer service is extraordinary. I boggle at the fact that with my Prime membership I can order a secondhand book for £2.80 and have it couriered to my door the next day, at no additional cost. I don't understand how a company that treats its customers so well can seem to have such scant regard for the welfare of its own staff – be it stock pickers in the warehouse or the well-paid accountants at HQ. And let's remember that we customers are also taxpayers, who in effect pick up the bill for Amazon's legal but morally dubious approach to corporation tax (although the company recently announced plans to reform its tax structure).

It's perhaps a reflection of my own moral turpitude that I haven't cancelled my Amazon account already. However, I will certainly send a copy of this column to Jeff Bezos, at

the address he invited staff to send their complaints to (jeff@amazon.com). Perhaps you'd like to send him your own thoughts, too. After all, if he thinks one poor customer experience "reflects a wider problem", imagine how seriously he might take it if just a dozen of us tell him what we really think of the way his company treats its staff.

 barry@mediabc.co.uk

Why Stephen Hawking is wrong about killer robots

A ban on autonomous weapons isn't enough. AI experts must do more than talk about risks



Nicole Kobie is PC Pro's Briefing and Futures editor. She hopes our robot overlords aren't offended by this column

When geniuses such as Elon Musk, Steve Wozniak and Stephen Hawking call for a ban on something, it's hard to disagree. When they demand a ban on killer robots, it's even harder to question their esteemed judgement. Yet, here I am, about to say that they and over a thousand of their clever colleagues in the scientific community are wrong.

To be clear, I don't disagree with the gist of their warning. A selection of academics and business leaders have argued in an open letter that autonomous weapons, those that "select and engage targets without human intervention", are feasible within years, not decades. That's a concern, they argue, as while they might reduce the number of human soldiers required to risk their lives in wars, they also lower the "threshold for going to battle".

"The key question for humanity today is whether to start a global AI arms race or to prevent it from starting," the letter reads. "If any major military power pushes ahead with AI weapon development, a global arms race is virtually inevitable, and the endpoint of this technological trajectory is obvious: autonomous weapons will become the AK-47s of tomorrow. Unlike nuclear weapons, they require no costly or hard-to-obtain raw materials, so they will become ubiquitous and cheap for all significant military powers to mass-produce."

Terrifying indeed, and while it's hard to argue against a ban, it's ultimately futile:

“I love that a delivery driver will knock on my door with a parcel at 9pm on a Sunday, but hate it at the same time”

governments will break it, just like restrictions on every other harmful facet of technology. There's simply no way the world's militaries will stop developing automated weaponry because of an open letter from Hawking and his friends, or even international law.

Take snooping, for example. For years, decades even, security researchers, tech experts and even journalists pointed out the inevitability of mass internet communications being used to snoop on citizens. Those who published stories on snooping programmes such as Echelon were dismissed as cranks. Now the Snowden revelations have proved their "paranoia" was nothing of the sort.

In the end, the letter does little more than assuage the researchers' guilt that their own technology will be used for immoral means – when it inevitably happens, they can at least say they tried to warn us. As the letter notes: "Just as most chemists and biologists have no interest in building chemical or biological weapons, most AI researchers have no interest in building AI weapons – and do not want others to tarnish their field by doing so, potentially creating a major public backlash against AI that curtails its future societal benefits."

So what does this much more stupid person expect these clever folks to do? They've taken the first step by identifying the problem and talking about it, rather than leaving the debate in closed rooms filled with military strategists. But now is the time to go further and take action, rather than wait until AI fighters are commonplace.

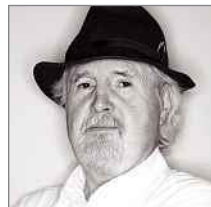
Again, look at surveillance: after the Snowden revelations, researchers doubled down on efforts to come up with anti-surveillance tools. There's now smartphones designed to block snoopers, such as the Blackphone; more websites have moved to full encryption; and even the tech behind Tor is being improved, meaning it could soon become the default method of surfing to avoid surveillance. If only we'd seen the value of such security work sooner.

So, to the signatories of that letter: you're smart enough to see the problem before it's stomping around the globe slaughtering people, so do more than write letters. Come up with systems to guard against killer robots, to prevent automated drones from targeting living beings, or to protect us from such terrors. My tiny brain can't even imagine what that involves, but I desperately want such protections to exist – because I'm pretty sure it's going to take more than a strongly worded letter to stop AI weaponry from killing people.

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The ten key rules of safety, whether in the sky or space

Hackers trying to attack planes may get the headlines, but it's plane's flaws that should worry us



Dick Pountain feels safe on Ryanair, where there's no entertainment system and insufficient room even to open a laptop

You were probably as disturbed as I was by a report, back in May, that a US hacker travelling on a Boeing airliner claimed to have penetrated its flight-control system via the entertainment system's Wi-Fi, making the plane climb and turn from his laptop. Aviation experts have since rubbished his claim (although Mandy Rice-Davies would definitely apply). But it did concentrate my mind on the fact that all modern planes employ fly-by-wire under software control, and that my confidence in software engineers falls far short of my confidence in mechanical engineers.

This nagging fear was made worse by the fatal crash of a military Airbus A400M in July, after its engine control software shut down three of its four engines just after take-off. An accidental erasure of some config files during installation had deprived the software of certain torque calibration

“To me, safety-critical software is about more than saving my own ass: it's been a concern for many years”

parameters it needed to monitor engine power. These vital numbers were being loaded from an external file, meaning the safety of the aircraft was being governed by a programming practice on a par with installing Windows updates. Nice.

To me, safety-critical software is about more than saving my own ass: it's been a concern for many years. I started out as a Forth programmer, when that language was widely used in embedded control systems, and attended conferences about both software and hardware architecture safety. Then I graduated, via Pascal and Modula-2, to becoming an admirer of Niklaus Wirth's

ideas on good programming practice, and finally on to object-oriented programming to control the structure of large programs.

Object-orientation is now the rule, supported by every language from JavaScript to Scratch, but I wonder whether it still means anything, or whether it's become a mere style. Loading critical data from unreliable external files violates the principles of encapsulation in many ways.

I did a bit of Googling and found lots of papers about safety-critical software and redundant hardware systems. Redundancy is a key safety concept: you build three separate computers, with CPUs from different manufacturers running different software written by different teams – which have been demonstrated to produce the same outputs from the same inputs. You then go with the majority verdict, the idea being that the same software or hardware bug is very unlikely to arise in all three.

The latest of these papers seemed to be dated around 2008. Surely the optimists have taken over the farm and started trusting too much? Then I stumbled across NASA's ten rules for safety-critical code. Give or take a Hubble or two, NASA has had few disasters caused by software, so here are its rules:

1. All code to have simple control flow constructs: no GOTO, direct or indirect recursion.
2. All loops to have a fixed upper bound, which can be statically proved never to be exceeded.
3. No dynamic memory allocation after initialisation.
4. No function longer than 60 lines of code.
5. The assertion density of the code to average a minimum of two assertions per function.
6. Data objects must be declared at the smallest possible level of scope.
7. Calling functions must check non-void function return values and the validity of all parameters.
8. Preprocessor to be restricted to headers and simple macros. No token pasting, variable argument lists or recursive macro calls.
9. Pointers to be restricted to one level of dereferencing, which mustn't be hidden inside macros or typedefs. No function pointers.
10. All code must be compiled with all warnings enabled at their most pedantic setting, and must be checked daily with at least one

static source code analyser, and pass with zero warnings.

These rules are aimed at C programmers, but they translate to most object-oriented languages. The heavy use of assertions is interesting: assertions are supported directly in Eiffel, Ada and some other languages, and can be added to C via the header "assert.h". They can specify the desired value range of some variable in program execution and raise a runtime error when not met: an example might be "assert(TorqueCalibrationParameter > 0)". When it comes to safety, you can never be too assertive.

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Mike Woodhead

Penetration tester



■ What does your job involve?

I'm the technical director and principal penetration tester at CQrity Limited. I perform security assessments of networks, hardware and applications for a variety of clients. The idea is to try to break in to the client's systems and find out how they can reduce their security risks. I also conduct social-engineering assessments – trying to coerce sensitive information, such as credentials or personal details, out of clients.

■ What skills do you need?

A good knowledge of networking protocols is a must, even if it's basic. For day-to-day testing, you need to know about TCP/IP fundamentals and the OSI (Open Systems Interconnection) model, and understand how firewalls work.

Being able to code is a big plus, whether it's simple Bash scripts or a language such as Python, Perl, Java, Ruby or .NET. There are open-source tools you'll use often, such as port scanners and vulnerability-detection tools, but when the tool you need doesn't exist, it's time to get your hands dirty and code something yourself.

Finally, it's important to communicate in a way the customer will understand. If you can't explain an issue in layman's terms, the customer may not fully grasp the risks you've discovered.

■ What does a typical day look like?

Most days start with a call to a client to confirm their requirements. You then perform the assessment itself, which usually involves numerous cups of coffee. At the end of the day, you have a wash-up call or send a debrief email, detailing what you've discovered and proposing a remediation strategy where necessary.

Really, though, there is no typical day. The best thing about the job is that every day brings new challenges. I might have to deal with a new network, new type of device, or an application coded in an unusual way. They all have their own little quirks: I like to think of it as Russian roulette for security geeks.

■ How did you get started in penetration testing?

I fell into it when I was a developer. I've never been one for sitting around killing time, so change-freeze periods used to drive me nuts. After moaning about having nothing to do, I was seconded onto a security-related project – probably to shut me up. I knew nothing about IT security, so discovering that people were conducting attacks against the sort of code my peers and I had been working on was a big shock. This was in 2002, and there was only one book on the subject, so it was very much a "suck it and see" approach to learning.

Once I started looking into security risks, I realised it was something that appealed to me. I had the same feeling as when I first started coding, like being bitten by the bug. I knew I didn't want to return to being a developer again.

■ What's the worst thing about the job?

No-one likes a security tester who might derail their release. You can get a name as a troublemaker, especially if people's bonuses depend on hitting a release date. That aside, reporting is probably the worst part. It's fine being able to exploit a system but, after the fun is over, you have to document all the issues you've found in a non-technical way. This is the most important part of the assessment, as it's what

£25k

Approximate starting salary

568

Permanent jobs (itjobswatch.co.uk)

£55k

Average earnings

the client is paying for, but it's also the least interesting. No geek particularly likes writing documentation.

■ How would someone get started in this career?

A few universities now offer "ethical hacking" degrees, but there's often a big gap between what's taught and the real world, probably because the lecturers don't have experience of penetration testing.

If you don't have a degree, it's common to make the leap from a technical support, networking or development background. If you have the foundation skills and show dedication, there's a good chance someone will give you a shot. The important part is to commit to constantly learning, and looking at different ways to approach an issue. There's always more than one way to skin a cat.

Attending security conferences can be beneficial too. There are a number of free conferences run every year in the UK, such as SteelCon in Sheffield and BSides in London and Manchester. You can mingle with people in the security industry, attend technical presentations and talk to companies that are hiring.

■ What's the pay like?

Most people work for a dedicated consultancy, with graduates starting on £15,000 to £25,000. At the upper levels, you can get involved in research and development, and a principal consultant can make more than £60,000. ●

Where to start

- An ideal site for beginners is pentestn00b.wordpress.com
- People with a bit more experience should visit The Gentleman Hackers Club's website (tghc.co)
- A collection of systems deliberately left vulnerable for you to hone your skills can be found at vulnhub.com

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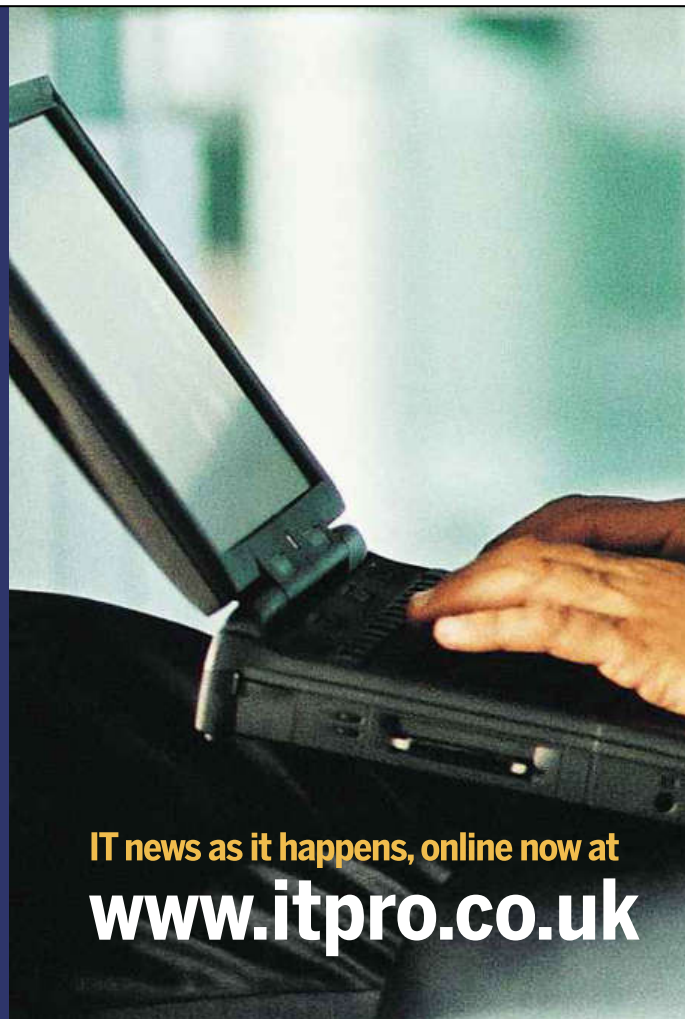
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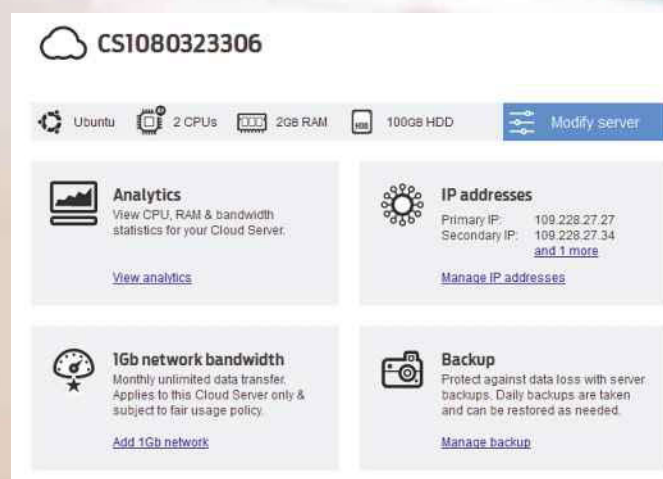
Richard Cullen, Managing Director at bluebox
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Readers' comments

Your views and feedback from email and the web

Meraki misgivings

I read Jon Honeyball's description of Meraki kit with interest (see *issue 252*, p110). I think Meraki wireless access points (APs) are how the majority of home broadband routers should be configured. But, when it comes to their switches and firewalls, I think the logic breaks down. Jon describes not having to be anywhere near the firewall to configure it, as it uses a web-based dashboard, but this means your kit is only as secure as your username and password combination. Do you really want that accessible from everywhere? There isn't even a two-factor option, and Meraki doesn't offer a rollback feature. I will stick with my Meraki access points sitting in my DMZ, but the rest of the range leaves me cold, and would worry me if I used it. **Mike Dear**

Jon Honeyball replies: A cloud-based control surface does demand high security, but Meraki is all SSL-encrypted, and has no problem with very complex passwords, which you can manage with a tool such as 1Password. Two-factor authentication using SMS can be found under "Update your account information" or you can use Google Authenticator. As for rollback, if you mess up a configuration you can reset the definition, which can be based on precooked defaults, and force the device to reload. I'm happy with the protection offered by Meraki, and delighted with its capability and functionality.

Substance over style

My ergonomic tip is to use your left hand for the mouse and your right for the keypad. I am right-handed and have never found this a problem. The next thing to address is ergonomics for the brain, also known as usability. The time taken to complete a task is no longer anything to do with hardware, but the design of the application. Many poor designs are widespread across applications, and improvements would be simple: for instance, for new files created from a template, it should be possible when creating the template to set a default path for saving the file. The list is endless. **Alan Wheatley**

Corrections

The Synology DiskStation DS214play, our former A-List recommendation, was described as having integrated Wi-Fi. In fact, this model lacks that feature. We apologise for the mistake.

Star letter

I have very poor eyesight, and would like to replace my old 19in monitor with a larger screen so that everything looks bigger. Sadly, modern monitors are widescreen, more suitable for watching TV and videos. This means, when I look at a text document on a widescreen display, it sits in the centre, leaving large empty areas on either side. The vertical height of a 24in widescreen monitor is little more than my present 19in model: I would need a 27in model to get a real advantage. With a screen of this size, I doubt that I could see the corners clearly without standing up to get close enough.

It seems to me that manufacturers are forcing serious computer users to use screens more suitable for watching videos and TV than for proper work. I shall have to stick with my old monitor until it gives up the ghost. **Michael Pearce**

Sasha Muller replies: I agree that the ubiquitous 16:9 format isn't great for everyday computing. The 24.1in Eizo ColorEdge CS240 on our A-List (see p19) uses the 16:10 ratio – and we're starting to see tablets with even more versatile 3:2 displays. Let's hope desktop monitors follow suit.

This month's star letter wins a 120GB Samsung 850 Evo SSD worth £53



Windows 10: the fallout

Thanks to all the PC Pro readers who wrote to share their experiences of Windows 10. Here are some highlights.

Windows 10 includes a lot of invasive settings and features. And, as every intelligent person should know, nothing in life is free: in around 12 to 18 months you'll hear "we've had to make Windows subscription-based." It will be too late, and too difficult, for most to revert to Windows 7. **Leonard Henry**

Would it be heretical for me to say Windows 8.1 works fine? I prefer the Metro Start screen to the Start menu, as my applications are all in instant view. My impression is that Windows 10 is not as responsive. **Solomon Cohen**

Before upgrading to Windows 10, I checked Microsoft's site: everything I use was flagged as compatible". But Microsoft Money simply shuts down with an error message. I know Microsoft no longer supports Money, but thousands of us have been unable to find anything as easy to use, and have continued using our licensed versions without issue – until now. **Dai Rees**

After upgrading I decided to use the "reset" feature to get a clean installation of Windows 10. But this stops you from reverting to Windows 8.1 if it all goes wrong – and of course it did. I lost access to Windows 10, and couldn't roll back to 8.1. I reinstalled Windows 8, and now have to reinstall all of the updates to get back to 8.1.



How can you be confident that the reset tool will work? If you try it, you lose the opportunity to roll back. **Charlie Hunter**

Is this some kind of joke? Why do I have to turn off myriad send-every-keystroke-to-Redmond switches? Why would I want Microsoft to control my microphone or camera? What's next? What cheese I put in my sandwich? It's Windows 7 that's the last edition. Windows 10 is just spyware. No-one with any sense will switch. **Clive Eplett**

My Windows RT tablet still does sterling service, and of course it's not going to stop working just because Windows 10 is out. But I'm miffed that, after barely two years, Microsoft is dumping me without an upgrade path. Is my only option to eventually move to Ubuntu or similar, assuming I can get it to install and run? **Chris Moxham**

I'm surprised that you haven't uttered a syllable about UEFI Secure Boot preventing Windows 10 systems from booting other operating systems. How will this affect me if I upgrade from Windows 7 to Windows 10? Your reception of Monoposoft's latest bid to master the universe is irresponsibly uncritical. **Ian Ray-Todd**

Darien Graham-Smith replies: Windows 10 systems can be hardware-locked to boot only operating systems signed by Microsoft. But it's up to the manufacturer to decide whether to implement this feature. And it only applies to brand-new PCs: if you upgrade an existing system, you'll always have the option to switch in the future.



An education in ergonomics

I have to take issue with one of the statements in the feature "Computing in comfort" (see issue 252, p42). The feature says "don't type on a tilted laptop", but a flat keyboard means that you have to stretch your fingers further to reach the keys at the rear edges, and raise your hands and forearms to reach the rear edge keys. If you use a tilted keyboard then your fingers can stay slightly curved, and that puts less

“The time taken to complete a task is no longer anything to do with hardware, but the design”

strain on your muscles, which is why most modern PC keyboards have optional feet.

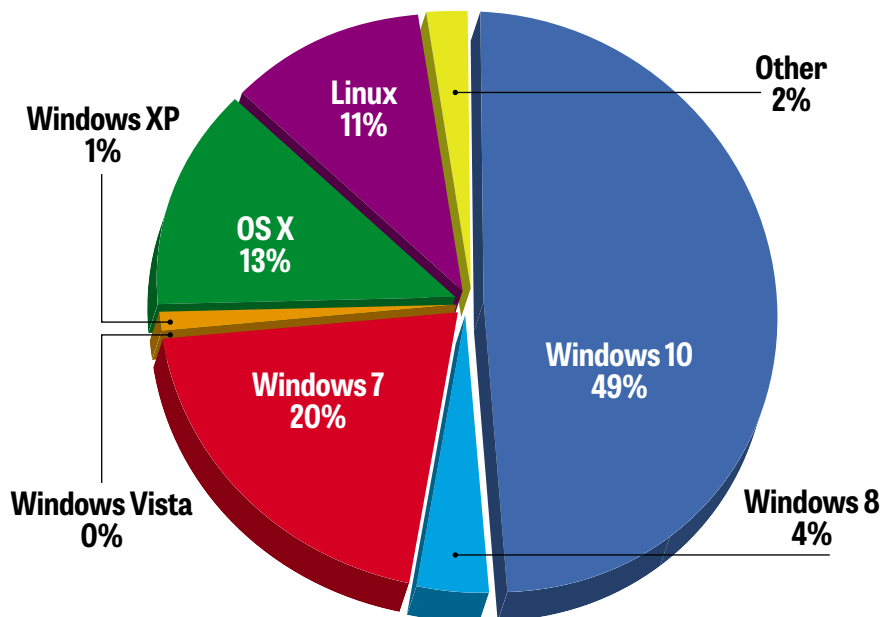
I damaged my right wrist in the 1980s, and suffered years of discomfort until I discovered that a sloped keyboard generated less pain. Since then, I have always used sloped keyboards, and even raise the rear edges where I can. Now I rarely, if ever, suffer any pain in the wrists, hands or forearms. The discovery probably saved my career as, without being able to use a keyboard, I wouldn't have been able to hold down many jobs since the 1990s. **John Allen**

Gapless playback

Ben Pitt's feature on music streaming (see issue 252, p32) was a great help for anyone unsure which bit rate to go for when ripping to a lossy format like MP3. But I think there's another consideration besides audio quality – transition between tracks. I suspect that this is mostly applicable to classical instrumental music: I have a 33-track CD of Beethoven's *Diabelli Variations* for piano. When I listen on a CD player, the music fades naturally at the end of each track, with a pause before the next just as you would hear in a live recital. Now I have ripped this CD to MP3, there is no pause, and each track begins before I'm ready for it. It's quite annoying. **Chris Stradling**

Readers' poll

We asked you: which is your primary operating system?



You can't argue with the numbers.

A mere month after the release of Windows 10, almost half of our poll respondents were using it as their primary operating system. The results are a storming endorsement of Microsoft's latest operating system – and a resounding rejection of its last attempt, with only 4% choosing to stick with Windows 8 now that its successor is available. OS X and Linux give a strong showing too, together accounting for almost a quarter of our poll respondents. And it looks like Windows XP is finally giving up the ghost: it's now less popular than iOS or Chrome OS as an everyday platform.

“Windows 10 is really easy to use. It just makes more sense than Windows 8.1” **Neill Kirk**

“After 25 years in IT, I've tried most systems, and I've settled on OS X. It's reliable and needs little administration” **Michael McLeod**

“I've had enough of Microsoft rewriting old, working features and introducing new bugs. I'm trying to move to Linux permanently” **Jase**

“I'd love to go back to Windows 98, but my games won't run on it” **Tanya Taylor**

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SWITCH TO LINUX

Not blown away by Windows 10? There are plenty of decent Linux alternatives – and we're not talking about the ubiquitous Ubuntu either

In this guide for those considering a fresh start with Linux, we've picked six of the best distros, each tailored to suit a different type of user or purpose. Then we've selected five applications that will justify your decision to make the switch. Finally, we'll help you take your first steps in a Linux environment, with the lowdown on how the operating system functions and how it differs from what you're used to in the Windows world.

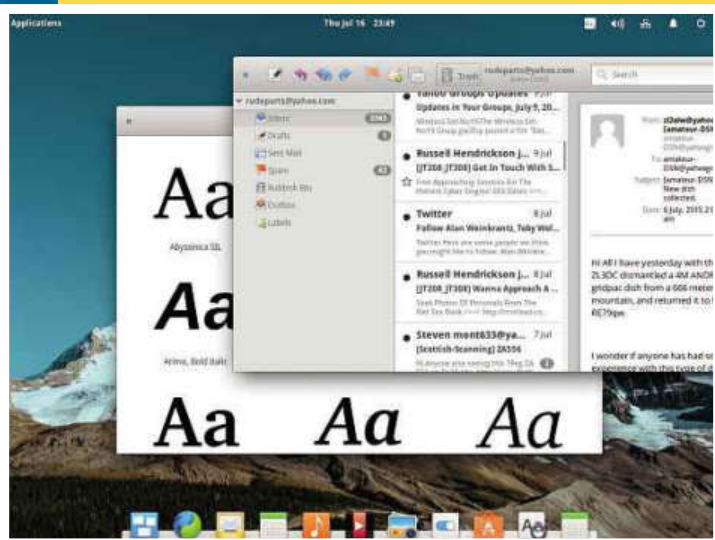
Contributors: Ian Betteridge, Rupert Goodwins, Darien Graham-Smith





SIX OF THE BEST

Not sure which flavour of Linux to plump for? Rupert Goodwins helps you decide



BEST FOR NEWCOMERS Elementary OS Freya



Linux has always had the horsepower, but not the looks. That's hurt it in the mass market, but then who's got the time to tune the UI for ordinary people? Elementary OS, that's who. Taking Ubuntu, it has imposed its own design and app selection, and made it clean and easy to learn.

The front-end, Pantheon, liberally borrows ideas from various sources – OS X's Dock is the most obvious – but melds them to create an experience of its own. It's very calm and restrained, rejecting the "more is better" aesthetic that's turned so much of desktop computing into a gaudy jungle. This minimalist approach carries through to the apps with a fundamentalist fervour. The only editor in the system is the aptly named Scratch, which makes Windows Notepad seem overly fussy. You can edit plain text in one size, one font, one style.

Consistency, usability and simplicity are key, but that does mean losing much of the flexibility that many Linux users find addictive. It also comes at the cost of the standard apps – LibreOffice, Firefox, Rhythmbox – that many existing users are familiar with. The browser is Midori, which is a perfectly good second-tier browser but lacks the sort of support the big guns get. Good luck getting it to work with Google Docs, for example. It's Ubuntu underneath, so you can put back all the apps you miss, but then you start to lose the Elementary magic.

It's not a distro for the power user. It certainly doesn't claim to be, and its simplicity will be too limiting for many, but put the rawest of newbies in front of it and watch them discover what computing feels like when it actually likes humans. It's also a work in progress – Freya is version 0.3 of Elementary, and it's not without its hiccups. But if it can encourage more apps to cleave to its design guidelines and grow in functionality fast enough to maintain its current interest, it has the potential to become a major player.

BEST FOR OLD HANDS Mint 17.1



The price users pay for native Ubuntu is having to cope with its capriciousness. In its search for the magic potion that will make the one Linux to rule all desktops – or tablets, or e-commerce, or whatever it is this year – Canonical has a habit of throwing out things people like and adopting ideas that make more sense for its corporate vision of the day than for those who use it.

Mint has become a popular alternative because it maintains a strong user focus. With the latest versions, for example, it has decided to stop following Ubuntu's six-monthly update cycle and stick with the Long Term Support calendar instead. Thus, Mint 17.1 will be supported until Ubuntu 14.04 runs out in 2019, and no new Mints will change their core Ubuntu system until 2016.

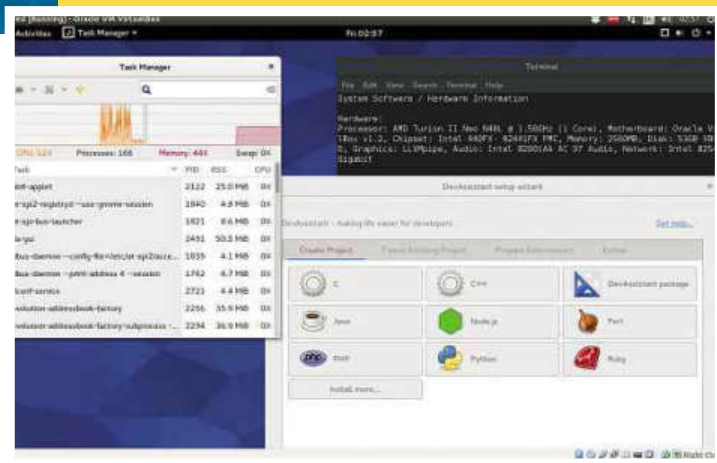
This might seem restrictive if it weren't for the fact that Mint is a stable, functional and mature system, and continues to receive updates that address actual user needs. The Update Manager rates updates by importance, so you can find your own balance between newness and familiarity, and it groups updates, which makes it easier to choose appropriate bundles. It's not a huge change, but it's welcome.

Mint has two desktop environments, Cinnamon and Mate. Cinnamon is the more popular of the two. It's unfussy, familiar and (being Mint-flavoured) repays all that time you've invested in learning how to use the classic mouse-driven model. Imagine Windows 8 had never happened, and that Microsoft had chosen to build on what it had started with XP and spiffed up in Windows 7. That, in effect, is what's happened with Cinnamon. It's a modern classic.

It doesn't pretend to be Windows, though. It's suffused with the spirit of Linux and runs well from the off, with vast configurability built on a stable base. Anyone who's worked with computers for a while knows the importance of being able to build new ways of working without having to replace old methods that are perfectly good. If you want an environment that respects that, doesn't obstruct your work and offers (rather than imposes) variety, you may care to join the cohort of experienced Linux users who've found Mint to their taste.



LINUX DISTROS



BEST FOR PROFESSIONALS Fedora 22



Fedora has a firm fanbase among people who work with Linux for a living, for a number of reasons technical, historical and cultural. The technical appeal comes from Fedora's background: it was developed by Red Hat and IBM alongside Red Hat Enterprise Linux and CentOS, two core distributions that run servers and other services for businesses. As a result, Fedora tends to receive updates ahead of its more buttoned-down brethren, which is great if you like getting early exposure to new software and don't mind being part of the debugging process. Plus, experience in Fedora transfers to the other environments. Certainly, if your business uses any of the Red Hat systems and you have any technical contact with them, Fedora is a good personal Linux to adopt.

This seeps over to the cultural benefits. All popular Linuxes have lively online communities, but Fedora's has a reputation for being friendly and professional. It's a given in modern computing that the primary support resource is Google search: the first tier is the online documentation and user reports, and the second is the community. Fedora's is unmatched, and the documentation is pretty good too.

As for historical: Fedora's primary desktop environment is Gnome, which has developed fitfully and with a few controversial decisions along the way. Fedora is as close as Gnome gets to a home platform, with updates appearing swiftly. Gnome's long history has resulted in a seriously powerful set of utilities and configuration options. There's little that can't be fixed, optimised or personalised using Gnome skills.

This all makes Fedora a good fit for serious-minded Linux users, especially those who develop software. One example is DevAssistant, a tool that takes care of a lot of the housekeeping involved in setting up a new project in various languages. It's open-source so you can use it how you like, but it's baked into Fedora, from where it sprang.

Fedora also comes in a wide variety of packages aimed at specific areas such as security, scientific computing and design. If you wear any of those hats, then Fedora may fit particularly well.

BEST FOR MAVERICKS Mageia



Sometimes it's just fun to get stuck into something different. Although Mageia has become fashionable recently, its lineage goes back to Mandrake Linux, a French fork of Red Hat Linux 5 started in 1998. After a spell as Mandriva (following a legal challenge by the trademark owners of cartoon character Mandrake the Magician) and a business collapse in 2010, a few ex-employees and other supporters turned the source code into Mageia and carried on.

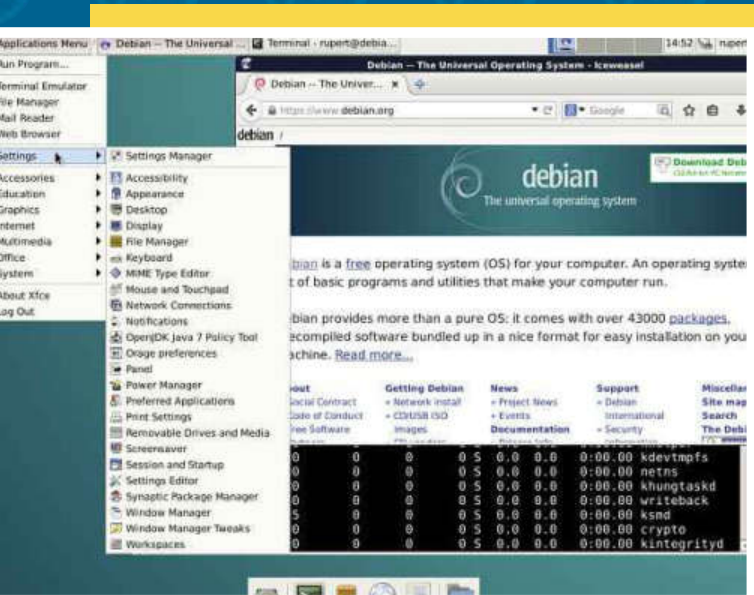
Being French and having a colourful history is no guarantee of technical excellence. Fortunately, Mageia is built on a mix of usability, independent thinking and community input to produce a distro that's quirky, fun and effective. Typical of this approach is its solution to one of Linux's perennial war zones: should you use software that isn't open, or that may have legal problems, such as an open implementation of a patented or unlicensable codec? With a shrug, Mageia leaves it up to you by dividing its repositories into Core, Nonfree and Tainted. The Core stuff is impeccable, Nonfree is proprietary, and Tainted is the stuff that's open to debate.

Mageia was an early adopter of the mix-and-match approach to window managers and desktop environments. You have numerous choices during installation – Cinnamon, Gnome, IceWM, KDE, Mate, LXDE, Openbox, Razor-qt, WMaker, Xfce – although the Mandrake/Mandriva ancestry ensures a strong contingent of KDE supporters.

Mageia is a community effort – it's not based on Ubuntu, Fedora or Debian – and the community spirit is very visible. The greeter app offers links to forums, support centres, chatrooms and documentation, as well as shortcuts to installing popular software without having to go into the installer. The result should be a system that's configured how you like it without you having to learn the details of the system beforehand. The same user focus applies to the system control panel, which puts everything you might need in one place.

Mageia doesn't have one killer aspect that makes it the right choice for any particular task, but it's the distro that gets you closest to its community and the way open-source software actually works. It's independent, passionate, flexible and fun.





BEST FOR SMALL-SERVER ADMINS Debian 8

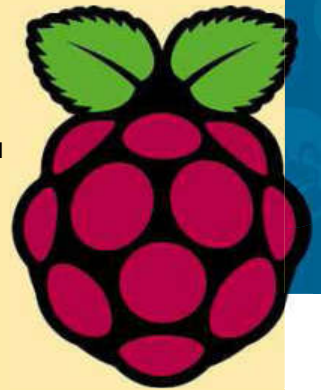
Debian is one of the grandfathers of modern Linux. Starting in 1993, and with its first full release in 1996, it aims to be the universal operating system and indeed is at the heart of many other distros. Even Debian's full name – Debian GNU/Linux – should give you a flavour of just how old-school the project is. Without going into the politics of whether or not all Linux is really GNU/Linux, adoption of the name is a shibboleth for staunch conservatism, of taking the founding principles of free and open-source software seriously and of not following fad or fashion. Debian was the originator of a long-standing and uncompromising set of documents, the Social Contract and the Free Software Guidelines, which have been influential in setting the standards by which the free-software community defines itself.

That self-image is backed by the Debian experience. Although it's possible to choose from a huge range of desktop and management interfaces during installation, the canonical Debian is austere and highly focused on delivering stability and continuity. Debian is certainly not an organisation to compromise on its principles, either – its browser, Iceweasel, is a fork of Firefox that came about in part because the copyright on the Firefox logo was incompatible with the Debian licensing philosophy. Likewise, the installation process asks a lot more questions than many, because Debian wants you to make choices yourself, rather than hiding important decisions behind defaults.

Because it updates relatively slowly, with major updates every couple of years or so, Debian retains a lot of old favourites such as the Synaptic package manager. It also comes with the usual set of office and media software. It's by no means only for the traditionally minded hacker, but is a particularly good fit for anyone who thinks that Ubuntu – which is itself Debian-based, of course – used to be better before they improved it.

Debian used to have a reputation for being very stable, but a little crabby and difficult to learn. The past couple of iterations have smoothed out the latter without hurting the former. It's the sort of distro that is particularly suitable for those who want to build a home or small-business server – something you want to just work and not need tampering with and fine-tuning forever afterwards. It also works well across a very large range of hardware, which makes it a good choice if you want to repurpose an old laptop by turning it into a network appliance or media storage hub, for example.

BEST FOR RASPBERRY PI OWNERS Raspbian



If you fancy reliving the thrills and frustrations of the early days of home computing, get stuck into the Raspberry Pi universe. The insanely popular and dirt-cheap single-board computer has attracted the attention of thousands of developers and supports over 20 operating systems, many of which are cut-down or specially configured Linux variants.

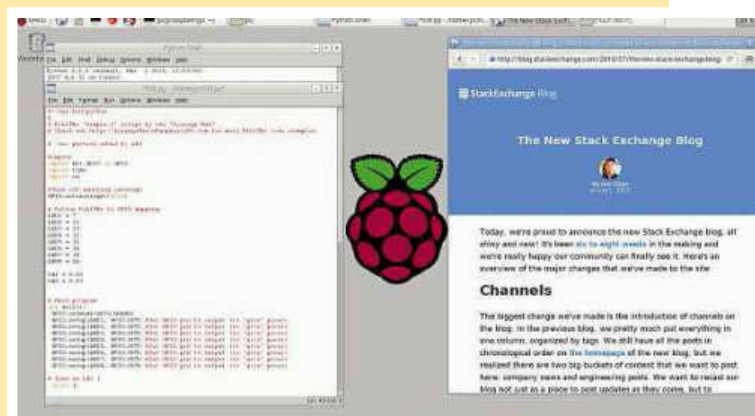
Sadly, not all of these run on the newer Raspberry Pi 2, which has a different ARM architecture to the original. This is a shame, as the Pi 2 has double the core count and twice the RAM of the original, and actually feels like a sensible platform for a full Linux OS. While there is now an Ubuntu derivative (Ubuntu Mate) and even a cut-down, GUI-free version of Windows 10, the standout Raspberry Pi OS is Raspbian. It's the "official" OS of the Pi and has seen by far the most development effort and community response in providing the Pi's unique hardware features with software support. It's supported by the Raspberry Pi Foundation, too, which gives it a huge advantage.

Based on Debian 7, Raspbian offers plenty of specialised configuration and management tools for setting up standard services, manipulating the hardware (including support for the Raspberry Pi camera option and Python libraries for the GPIO interface pins) and a customised LXDE desktop manager that provides an appropriately simplified way of getting at apps. There's a large base of utilities, productivity and just plain fun software to choose from. (Whole villages have disappeared into Minecraft, never to be seen again.)

As standard, Raspbian takes up around a quarter of the Pi 2's gigabyte of RAM, but if you're not bothered about LXDE and graphical support – for example, if you're running the Pi 2 as a headless file server or hardware development system – you can easily get that down to well under 100MB.

Although the profusion of OSes for the Pi makes it easy to dissent – and the development effort to produce more is still growing – Raspbian's status as a robust, simple and fully integrated version of Linux for the device is secure. It does what any good OS should do, which is to provide all the options and support you need to satisfy your inventive urges without introducing its own dramas and delays.

It arrives as part of the cutesily named NOOBS installer, which you can download from the Raspberry Pi Foundation's website (raspberrypi.org/downloads/noobs), and which even a Family Fortunes contestant could work out how to install. You'll need an SD card with at least 8GB of free space to run Raspbian on the Pi, although you may want to afford yourself a larger-capacity card to provide some extra room for storage.



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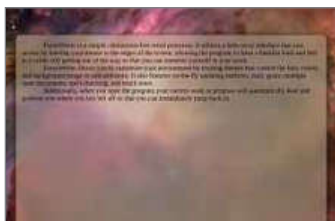
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FIVE APPS THAT WILL MAKE YOU WANT TO SWITCH TO LINUX

Ian Betteridge picks his favourite Linux applications

When people switch to Linux, they usually do so for ideological reasons. However, there are some exceptional cases where Linux software outstrips its equivalents for Windows and OS X. Here are our five favourites. Not all of them are Linux exclusives, but they originated on the platform and are often better maintained on it.



Focuswriter

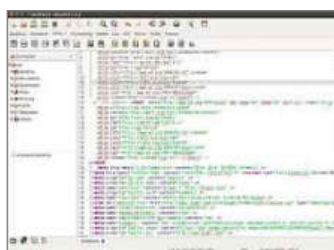
gottcode.org/focuswriter

We journalists are partial to writing tools. Focuswriter is one of the very best – and it originated on Linux.

For those who aren't familiar with the idea, distraction-free writing programs are intended to be the polar opposite of Microsoft Word or LibreOffice. Instead of offering toolbars cluttered with options, they limit you to plain text and keep formatting options to a minimum so that you spend more time worrying about the writing than whether Bell MT is better than Calibri.

Focuswriter hides everything except the text, although it has a few useful options, such as the ability to set timers (to ensure you take breaks) and a Daily Progress view, which gives you a breakdown of how many words you've written each day, formatted nicely on a calendar. You can also set a daily goal (in minutes or words), and customise the theme to your taste.

It's a great little application, and probably the best focused writing app you'll find for free.



Bluefish

bluefish.openoffice.nl

If Focuswriter is manna for writers, Bluefish is its equivalent for coders. It manages to be both stupendously powerful and lightweight, and although it has been ported everywhere, Linux is its home and tends to receive new features first.

So what's so great about it? First, it's comprehensive: if it's a programming or scripting language, Bluefish will have definition files that format it beautifully for you. It also has in-line reference information for functions, which saves you time when you're struggling to untangle someone else's code (or even your own). You can even integrate external programs to set up incredibly powerful text-processing tools of your own.

Of course, it has support for advanced search and replace using regex, and you can edit remote files via a wealth of protocols. But it's the small touches that make Bluefish a joy to use, such as a spell checker that ignores code and checks only the prose content.

Amarok

amarok.kde.org

Commercial media players are either too buggy or too confusing for anyone to want to use them regularly. Amarok is like stepping back in time to the days when music players just worked – even though it has more features than proprietary

rivals such as Windows Media Player and the loathsome iTunes.

Amarok integrates with a host of web services, so everything you play can be scrobbled to Last.fm, for example, or you can use Echo Nest for recommendations based on what you're playing. There's also a well-tended podcast directory.

Amarok offers dynamic playlists based on simple queries ("all rock tracks from 1969", for example). Managing your music collection is really simple, and includes a "file-tracking" feature so that if you move files around, you shouldn't lose them from your Amarok database. As you'd expect from Linux software, it's



scriptable too – and for those who don't want to write their own, there are plenty of community-developed scripts available to do pretty much anything you're likely to want.

VirtualBox

virtualbox.org

VirtualBox is an open-source, cross-platform virtualisation environment that lets you run multiple operating systems at the same time, or run software that isn't available to your OS. This is often essential for Linux users – so it's no wonder VirtualBox is very well developed on the platform. It's not exclusive to Linux, but we've found that it performs best on Linux, and you can bet that any new features will be compiled into Linux first.

VirtualBox really comes into its own when running multiple



Linux-based virtual machines. This gives developers a "safe" environment to test software in without the risk of bringing down their entire computer. They're essential for testing, and Linux is the best operating system to run them on thanks to its relatively low overheads.

Package managers

All of them

This one's a bit of a cheat, but it's a chance to praise a Linux feature that has also influenced the proprietary computing world.

Package managers such as RPM automate the process of installing, updating and deleting software. Searching for the software you need is a doddle, and once it's installed, the package manager takes care of updating it for you.

If this sounds like the Windows and OS X app stores, it should: both are glorified package managers with pretty front-ends. That Apple and Microsoft should in effect copy the idea from Linux is something we should all acknowledge. It's probably the single-biggest contribution Linux has made to mainstream software.





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FIRST STEPS WITH LINUX

Darien Graham-Smith explains the things to watch for when you first make the switch from Windows

Switching to Linux is easier than it used to be: you can set it up and get working just as easily as you can with Windows. Inevitably, though, there's a learning curve, as Linux has its own ways of doing things. Here's what you need to know when taking your first steps with your new OS.

Accounts and permissions

When you want to change system settings or install software in Windows, a User Account Control (UAC) requester pops up and ask for authorisation. Most Linux desktops work in a similar way, although you'll probably be asked to enter your password rather than click a button.

It's useful to understand why these requesters appear. The user account you create when you install the OS can't change system settings at all. This is one reason why Linux systems have historically been considered very secure and stable. You can't screw up your whole system even if you try, and programs launched from your account can't either.

If you want to make system-wide changes, such as changing your startup options, you have to do it through a special "superuser" account called "root". Logging in as root is considered very dangerous, precisely because it gives you, and the programs you run, unfettered control over the system. Some distributions (including those based on Ubuntu) disable the root account so you can't log in as root even if you want to.

Instead, Linux gives you the ability to launch a specific process with root privileges, while everything else retains the restrictions of your regular account. When a requester pops up asking for your password, it's seeking permission to elevate a particular task. If you're using the

terminal (see opposite) and want to execute a command with root access, the command is **sudo**, short for "superuser do".

File attributes

Linux's user model isn't just about disallowing potentially dangerous commands. Every file on a Linux system has a set of attributes detailing (among other things) its owner, and who's allowed to access it. If you seem unable to open a file – or you can read but not write to it – this

systems, but on a personal computer you don't need to worry about it.

The directory structure

Windows arranges things on your hard disk in a superficially logical way: user folders are stored in C:\Users, programs live in C:\Program Files, Windows system files live in C:\Windows, and so on.

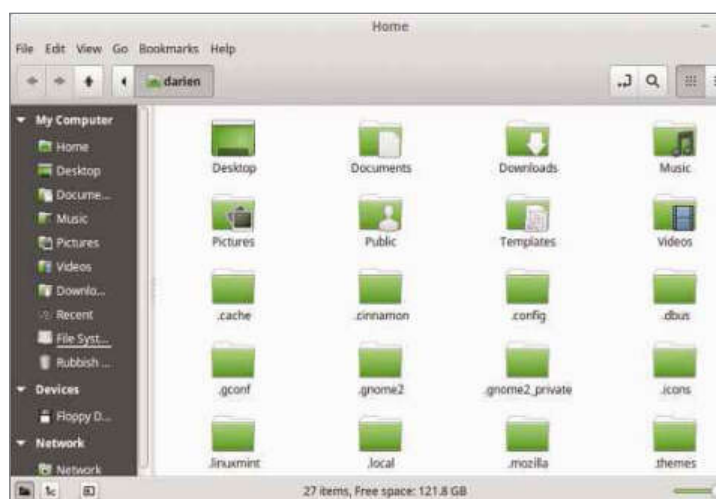
Things are similar in Linux, but not the same. If your username is Ben, you'll find your user folder at /home/ben. You'll notice that the

slashes are the other way round in Linux, and there's no drive letter: the root folder, which is referred to with a simple slash, is actually a virtual location, which you can think of as equivalent to "This PC" in Windows.

Username are conventionally stated in lower-case. Linux is case-sensitive, so if you go looking for a folder called /home/Ben you won't find it. You'll probably use the graphical file manager most of the time, so this shouldn't be a problem,

but it can catch you out. It's worth mentioning that "~" in Linux is a standard alias for your home directory – so if you're at the terminal, instead of typing `cd /home/ben` you could simply type `cd ~`.

Feel free to click around to see how the rest of the file system is arranged. You can't cause any serious damage as long as you don't do anything that requires root authorisation. Aside from /home, the locations you'll probably hear about most often are /bin, where system software lives, /usr/bin for user applications, /etc,



suggests that your account lacks the necessary permissions. Root, of course, can read and write everything, so the answer is normally **sudo**.

If you want to change the attributes on a file, you can do so from within the graphical file manager, or from the terminal using the **chmod** command. You can change a file's owner, or set read, write and execute permissions separately for its owner, for everybody, or for all users in a specific group. The ability to divide users into groups is useful for administering large multi-user

BELOW Like Windows Explorer, Linux groups your files in a convenient series of folders

which stores configuration files, and /dev, which contains pointers to physical devices such as USB flash drives. But don't sweat it: again, if you stick to the desktop, you'll never need to worry about these locations.

Installing new software

Think Windows 10 is fancy with its app store? Linux has had its own equivalent for decades.

Most distros include a graphical package manager, which you use to find and install all sorts of software. Ubuntu's is called Software Center, but there are plenty of others to choose from, including Aptitude, Synaptic and Gdebi – and they can all be installed from within your default package manager.

To an extent, which you choose is academic as they all offer the same software. Your package manager will come set up to talk to the biggest repositories of popular free software, such as Firefox and Skype. If you want a program that isn't offered, you can configure your package manager to search additional repositories. You can optionally include "unstable" software that's under development or unfinished, and you may have the option to include non-free software that comes under more restrictive licences.

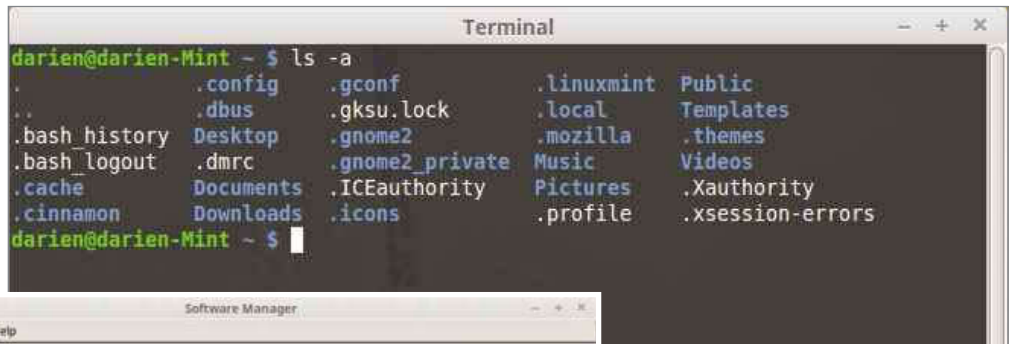
Compared with Windows, Linux software skews very much towards free, open-source offerings. You might miss familiar tools such as Microsoft Office or Adobe Photoshop, but these days their free equivalents are remarkably powerful – and, as we note on p40, there are some great apps that you might not have heard of.

Also, unlike Windows applications, Linux apps can't tamper with your system settings or startup options. There's no Registry in Linux, so you don't have to worry about clogging up your system with badly behaved applications. And uninstalling a program is as easy as heading back into the package manager and clicking Remove – or your distro's equivalent.

Filetypes

When you double-click on a file in Windows, the operating system determines the type of file by looking at its extension – so DOCUMENT.DOC opens in Word but DOCUMENT.XLS opens in Excel. In Linux there are no extensions – content information is embedded directly into every file.

This identifier is commonly called a MIME type ("Multipurpose Internet



ABOVE The terminal is an incredibly powerful tool, but using it isn't obligatory



ABOVE Package managers make it easy to find and install new software

Mail Extension"), although these days the proper term is "internet media type". It allows any application to look at a file and know immediately whether it's an application, image, text file or what have you.

This means you can't tell what a file is from its filename – but you can look at its icon within the file manager to see what the system thinks it is. What if you want to open a file with something other than the default? Like in Windows, most file managers let you right-click and select Open

With to choose a different default application for that file type. Or, you can open a file with a particular program just once – helpful if, for example, you want to import a text file into LibreOffice Calc.

Hidden files

In Windows, system files are hidden from view by default. Linux also hides certain files, but usually preference or configuration files rather than anything critical – they're hidden to avoid clutter rather than to discourage meddling.

Unlike in Windows, there's no specific file attribute in Linux that marks a file as hidden. Rather, hidden files are identified by a dot at the start of their filename – so, for example, in

your home folder there's a hidden file called .PROFILE that stores information such as the default paths to search when you type a command into the terminal. If you want to view these files there's usually an option to do so in your distro's file manager.

The terminal

Some people think you need to master Linux's command-line interface, the terminal, to use the OS effectively. In fact, you can be happy and productive without ever opening it. All the same, Linux wizards tend to make extensive use of it because it's so powerful and efficient: with a few commands you can do almost everything from here, including installing programs and carrying out administration tasks.

Of course, learning the ropes takes time. Some of the basic commands are different on Linux and Windows: the **dir** command works in most distros, but it's an alias for the real command, which is **ls**. You can use **cd** to move around directories, but to copy a file the command is **cp**; to move or rename a file it's **mv**. To view the contents of a file, use the **cat** command. You can get more details on how to use these tools with the **man** command – so, for example, you'd type **man cat** to find out more about **cat**.

You can create scripts just as in Windows, and a program or script can be launched by simply typing its name. But remember that a file needs the right attributes set in order to be executable: use **chmod a+x** plus the name of a file to add the "executable" permission for all users. And your search path takes precedence over your current directory, so rather than typing **myscript** you may need to specify **./myscript** – otherwise a different script with the same name might be executed instead.

Don't forget that, like everything else in Linux, terminal commands are case-sensitive. Entering **ls -l** will show you the contents of a directory, along with the permissions, owner and creation date. But **LS -L** will merely return an error. ●



"The user account you create when you install the OS can't change system settings at all"



How to Secure Chrome

Our resident security expert **Davey Winder** investigates whether Google Chrome really deserves its reputation for hardened security – and shows how to make the browser even safer

Ask a roomful of people to name the most insecure web browser and hands will quickly shoot up to answer: “Internet Explorer”. Ask people to pick the safest, and “Chrome” will be the answer on the lips of many. But how true is that in reality?

It depends on how you measure safety. The Secunia Vulnerability Review suggests that known browser vulnerabilities increased from 728 in 2013 to 1,035 in 2014, with most rated as critical. Safari had the fewest, followed by Firefox, Internet Explorer and then Chrome. Secunia also took patch status into account: the more users with unpatched vulnerabilities, the less secure the browser. Using this metric, Internet Explorer is easily the safest, followed by Chrome, Safari and Firefox. Rank them by risk exposure (calculated as market share multiplied by unpatched users) and it all changes again, with Firefox at the top, followed by Chrome, Internet Explorer and Safari.

At the last Pwn2Own zero-day hacking contest, Internet Explorer 11 (64-bit with Enhanced Protected Mode enabled) ranked in last place with four vulnerabilities exploited, followed by Mozilla Firefox on three, Apple Safari (64-bit) on two and Google Chrome (64-bit) with just one.

These four different results from just two reports reveal that, while Chrome may be reasonably secure, it's not bulletproof. Let's start by looking at what Chrome does well, and then address how you can improve it.

Sandboxed structure

From the moment Chrome launched, Google made security a priority. The internal sandboxing architecture makes things hard, if not impossible, for those who want to exploit a vulnerability. The HTML rendering and JavaScript execution processes also live in the sandbox, adding a

strong layer of protection. Chrome also tries to stop you visiting sites that may infect your computer, by warning you if a site is potentially unsafe. The third prong in Chrome's security trident is automatic browser updates, which are regularly performed in the background to ensure you always have the most recent – and therefore most secure – version.

It's possible to switch off the warnings, but thankfully this option is in the browser's Advanced Settings, which will hopefully stop casual tweekers disabling a useful security feature. You will also find the Do Not Track setting here. Despite being the last of the big players to add such a feature, Chrome has caught up and now allows you to disable cross-site user tracking for the purpose of serving adverts. Not all sites respond,

“Chrome's sandboxing architecture makes things hard, if not impossible, for those who want to exploit a vulnerability”

but it's a privacy option worth having – as are the Chrome Incognito and Guest features for removing history and cookies when you finish a session. Guest mode goes furthest, not allowing the user to modify (or even see) the profile of the browser owner.

Extensions can be both a blessing – providing extra features such as the LastPass password manager – and a curse when developers abuse them. They can also inject malware into the browser. Google has attempted to counter this by insisting that all extensions for Windows Chrome users must be hosted in the Chrome Web Store. In the year since the policy was introduced, there has been a 75% drop

in support requests for uninstalling unwanted extensions. The same walled-garden approach is now being rolled out for Mac users, and the Windows developer channel is following suit after some malicious software was found to be forcing users to install off-store extensions.

Password problems

Although security should be seen as a process rather than a product, sometimes a product doesn't help. For example, Chrome can leave your site passwords exposed to anyone who has access to your computer. Of course, you shouldn't leave your computer unattended and accessible to others, but if you forget to press Windows+L before you go for a coffee break, you don't want your web browser making site password retrieval as easy

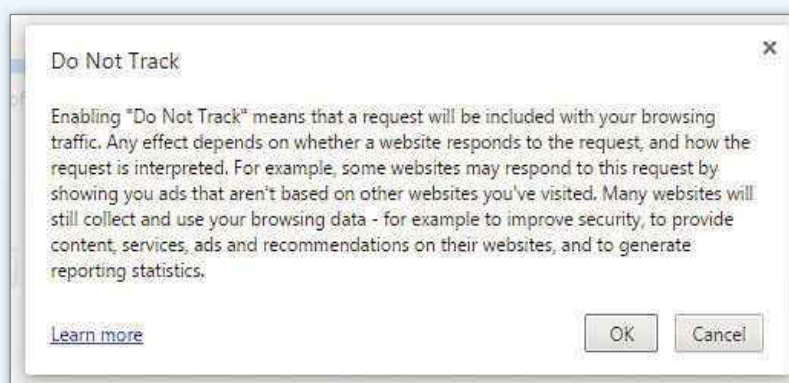
as typing **chrome://settings/passwords** into the address bar. Do that in Chrome and, if you haven't locked down the client so as not to “offer to save your web passwords”, a list of sites and associated passwords appears. The passwords are initially hidden behind asterisks, but only until you click on the entry and hit the

Show button to reveal them.

Unlike in other browsers, these stored passwords are not themselves password-protected. You shouldn't let ease of use trump security – don't let Chrome store your logins like this. Instead, install a dedicated password manager such as LastPass, which encrypts your logins and requires a strong master password to access them. Even if someone gets access to your computer, your logins should remain safe if you've opted for a secure master password and two-factor authentication. Chrome doesn't even make it easy to opt out of this insecure password-storage system: the option is tucked away in Advanced Settings, which is at the bottom of the standard Settings screen and requires a further click to access.

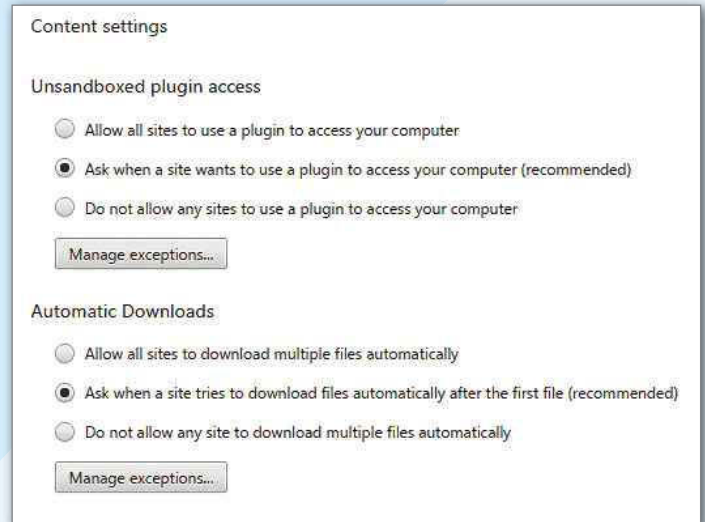
Chrome can also synchronise your settings and saved data across multiple devices, opening an obvious security risk – especially when all that's required to sync your browser data is your Google account password on a new device. Couple this with a user who saves site passwords in Chrome, and the danger is easy to see. Thankfully, it's also easy to stop. First, follow our advice about not saving site passwords in Chrome. Then add

RIGHT Do Not Track isn't perfect by any means, but it costs nothing to enable it





ABOVE Let Chrome encrypt everything, including the kitchen sink



ABOVE Don't be afraid to adjust the advanced settings

another layer of security by encrypting your synced data with a passphrase that's stored on your computer and isn't transmitted to Google. You'll find this option in the standard settings by clicking the Advanced Sync Settings button and choosing either to encrypt synced passwords or all synced data (go for the latter) with a passphrase of your choice.

If you forget your passphrase, you can reset the sync from your Google Dashboard, which deletes all synced data from the Google servers and disconnects your synced devices. The data on your devices is not wiped, however, so all your bookmarks and preferences will remain for when you re-enable sync with a new passphrase. As yet another

layer of security, turn on two-step verification (pcpro.link/253chrome) to prevent anyone else signing in from an unknown device, even if they have got your Google account password.

Speaking of passwords, along with the LastPass extension, you should install the Google Password Alert extension. This only protects your Google account password, but as this is used for an increasing number of applications and services, it's a worthy addition to your arsenal. It uses a secure thumbnail of your Google account password and compares it with thumbnails of your most recent keystrokes in Chrome, alerting you if your password has been entered into a non-Google site and

helping thwart phishing attacks.

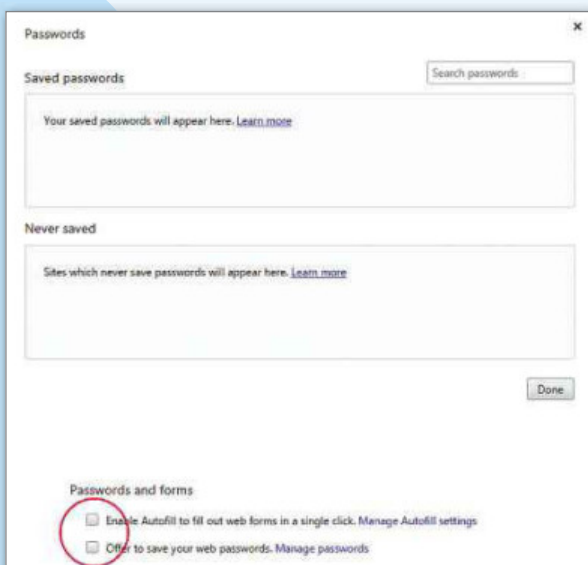
Initially, researchers were able to bypass the system, but Google fixed this and it now works as expected. It still only operates within the browser when JavaScript is enabled and doesn't protect apps, extensions or incognito tabs unless configured to do so. You can configure this by typing **chrome://extensions** into the address bar and scrolling down to the Password Alert options. The "allow access to file URLs" tickbox is only of use to web developers.

Hardened browser

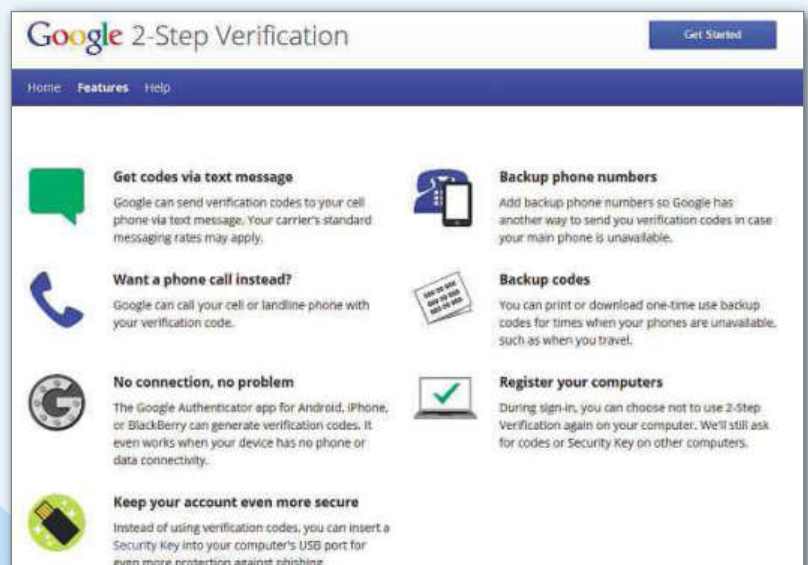
Despite the marketing claims, Google Chrome isn't secure. No web browser is. They all need to be treated with caution and hardened through configuration, extensions and safe browsing practices. Use Chrome as the basis of this browsing ecosystem and you will be off to a good start.

Turn over for advice on how to secure your Chromebook.

"Despite the marketing claims, Chrome isn't secure. No web browser is. They all need to be treated with caution"



ABOVE You don't need autofill, and saving plain-text passwords in your browser is a security no-no



ABOVE Using two-step verification is a great way to strengthen the security of your Google account

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How **secure** is your Chromebook?

The browser-based Chrome OS negates many of the risks facing the mobile user. Because a Chromebook can't install software, many pundits say that you won't be affected by viruses, Java applets or Flash, or malware attachments in email. However, a Chromebook is not 100% secure.

It's true that software can't be installed, but web apps can. The Google Chrome Web Store keeps most dodgy apps at bay, but "safe" apps have been known to turn rogue and inject ads into web pages or act as spyware.

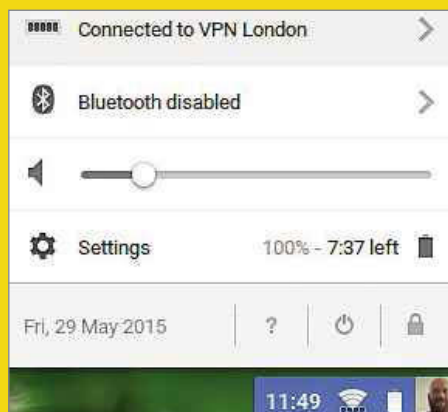
Chrome OS performs a verified boot at every startup to ensure the OS hasn't been tampered with, and if any signs of this are detected (or if there is any corruption), the system repairs itself to a clean state. There's no Patch Tuesday to worry about or system security upgrades to look out for. Chrome OS automatically updates itself and downloads the necessary files in the background, installing them at your next startup without any user intervention. So, overall, the Chrome OS is pretty secure, but that doesn't mean you can drop your guard.

It's pretty easy to further secure your Chromebook with some quick fettleing. Mitigate the web app risk by using Guest mode instead of signing in with Google, as this disables installed apps and prevents the installation of others. Guest mode also erases your session data and downloaded files when you log out. Think of it as Incognito on steroids. Talking of privacy issues, if you lose your Chromebook, your files will remain safe thanks to the built-in encryption, as long as your Google account password isn't compromised. If you wish to sell your Chromebook, use the Settings | Advanced Settings | Powerwash option to reset the device to its defaults and delete all local data.

For the most part, you rely on being online to use your device, so insecure public internet access is a threat. Mitigation is the same as for a £2,000 Windows laptop: use a virtual private network (VPN). However, using a VPN on a Chromebook can appear daunting, as you can't just install an app. If your VPN provider supports L2TP over IPsec (or OpenVPN with more fiddling), it's straightforward. Here's how to install the Hide My Ass (HMA) VPN on a Chromebook.



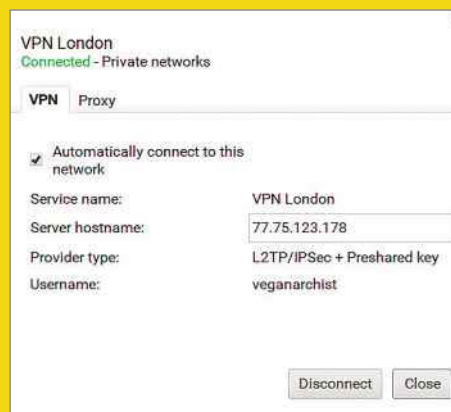
1 Open your Chromebook Settings screen and select Add Connection, followed by Add Private Network.



3 Click Connect and, if all is well, you will see the chainlinks appear below the signal strength logo, which shows that you're connected to your VPN.



2 Enter the chosen IP (from those supplied by your VPN provider) into the Server Hostname space and use any Service Name you wish. Select L2TP/IPSec + Preshared Key from the Provider Type dropdown, then enter the preshared key you have been given. Note that while the username you enter is as you'd expect, in the case of HMA the password is the PPTP password, which you'll find in your desktop VPN control panel.



4 Right-click that logo and, from the Settings screen, select your private network again to reveal a configuration window. From here tick "Automatically connect to this network" if you want to use your VPN connection by default, rather than forgetting to enable it while you're out and about.



5 To delete a VPN go to Settings | Private Networks | Preferred Networks and hover the pointer over the entry you want to delete until the "x" appears.





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TECH WEEKENDERS

From touring São Paulo with a perfect stranger to co-writing a novel and battling aliens, **Stuart Turton** uses technology to try out some completely new experiences

Sometimes it feels like technology has become the world's most overprotective parent, baby-proofing every experience long before we get anywhere near it. No matter what our weekend plans, GPS will make sure we don't get lost, TripAdvisor will rank the fun to be had, and apps will call us a cab home after we have one too many glasses of wine.

While there's no way of yanking this everyday crash mat from underfoot, I've lately wondered if technology could be used to sneak some adventure back into my life, rather than constantly ushering me away from it. To find out, I spent a few weekends using websites and apps to try new things and meet new people, aiming to come out on the other side with a friend and an amazing story to tell – the odder, the better.

Friends in dangerous places

Purely by coincidence, the first weekend of my tech adventure takes place while I'm holidaying in São Paulo, Brazil – a city famed for its ambience, weather, and murder rate. Even nighttime doesn't arrive here unarmed.



MAKE
NEW
FRIENDS

BELOW Steffen Ohnemüller enjoys a well-earned beer after showing me around São Paulo

Little wonder then that, an hour after landing, I'm looking for somebody to hold my hand. That person is German sports correspondent Steffen Ohnemüller, a São Paulo resident who I meet through Rent a Local Friend (rentallocalfriend.com), a website that pairs tourists with locals willing to show them around.

The service works by matching your interests with the profiles of locals who have a few hours to spare. My passions include sport, beer and not dying horribly, which I'm worried might be too specific until Steffen meets me in the lobby of my hotel with two bicycles and a list of his favourite

cafés and bars. "São Paulo's got a bad reputation, but I've lived here since the 1990s and never seen any trouble," he says.

Despite Steffen's well-intentioned pep talk, cycling around São Paulo seems only marginally safer than putting tigers in petting zoos, but he manages to quell my terror in just one afternoon. Wobbling up hills and along busy roads, he leads me through sprawling street markets and huge parks into beautiful neighbourhoods, where beautiful people walk beautiful dogs, without a care in their beautiful heads. In between, we talk about sport (Steffen commented on the World Cup in Brazil for German television last year), work, travel, books and reasons for using rentallocalfriend.com – namely to kill time between assignments. Come evening, we're sat on his balcony drinking home brew while night edges cautiously towards the city. "I try to show people the things about the city that appeal to me," he explains, when I ask whether he's

ever had a bad experience with a tourist. "Sometimes, they don't really understand that, and want more of a traditional type of tour with dates and landmarks. This is a different kind of thing."

I'm so enamoured with Rent a Local Friend that, when I return to London, I decide to give it another whirl. To keep things fresh, I switch my interests from beer and sport to long walks and urban culture. This pairs me with Catherine Loures, a Brazilian art director working at a marketing





firm in East London. We're friends within ten minutes, principally because she feeds me banana cake bought from the street food market in Haggerston where we meet.

As with Steffen, we spend most of the day together, eating our way through Borough Market and along the South Bank, before catching a bus towards the Serpentine Gallery. It's not so much a tour as hiring a chum with which to hang out. There's no specialist knowledge at work beyond a familiarity with the local area and a willingness to spend a day chatting with a stranger. Catherine fills me in on the finer points of astrology (my moon's in Sagittarius apparently), while I mock the finer points of astrology. By the time we wave goodbye at the bus stop we've agreed to meet again so I can show her around West London. That's right, I've already made a friend. I knew this would be brilliant.

Aliens vs spies

After the roaring success of my first tech weekender, I think bigger for my second. Now that I've made a friend, the onus is on having a story to tell. To that end, I've joined seven million players across 200 countries fighting a mass alien invasion on their smartphones. Given that my phone is a first-generation Moto G, this is the equivalent of Luke Skywalker attacking the Death Star in an old wheelbarrow.

All of this excitement comes courtesy of Ingress, an Android and iOS game that involves forming a team and wandering the streets of your hometown to capture territory splashed in fountains of neon light. Or, at least, that's the hope. Despite its large following, I spent a week struggling to find anybody with whom to play. The Google Groups where the teams converge were either inactive or marked as private, and my

ABOVE Eating my way through Borough Market with art director Catherine Loures

requests to join were ignored. Emails bounced back, or simply fell on deaf ears. It was like

turning up to a paintball session and finding padlocks on the doors.

Eventually, I manage to contact one player – MichaelC47 – who agrees to meet me at Victoria train station with a few of his Ingress-playing pals. After half an hour, it becomes obvious that they're not coming. I'm not sure if there's simply been a breakdown in communication or if they've been captured by the enemy, but there's no response to my messages.

Rather than abandon my heroic tale, I decide to try playing solo.

It turns out that playing a team game without a team is as much fun as running face first into a urinal. Even if I had found a platoon, it's still a game about walking somewhere and pressing

a button repeatedly until a light changes colour. Anybody who gets a thrill switching on a touch lamp will probably have a ball with it, but I'm not one of them.

Reserve booking

Thankfully, my weekend's salvaged by an email from Laura Callender. I met Laura online three days ago, and now we're writing a novel together. To be accurate, I'm

writing a novel with 20 complete strangers – all of whom are being corralled by Laura as part of her established project called Collaborative Writing Challenge (collaborativewritingchallenge.com), which has already produced one published novel and has two more on the way.

"I'm an impatient person," says Laura. "I see an end goal very clearly, but the process of getting there frustrates me beyond belief. It was the same with novel writing; I had the beginning and the end, but how on earth was I supposed to write the middle? That's when I realised that a collaborative novel could work."

It works like this: New York-based

Laura comes up with the vague outline of a story, then opens the door for collaborators to write individual chapters to her deadlines. They have a summary of previous events, but can take the story in whatever direction they want

from there. Adding a Thunderdome vibe to proceedings is the fact that Laura commissions three different writers for each chapter, with the best submission elbowing its way into the

final novel. She compares the process to entering a writing competition, except that, even if you don't win, there's still feedback and encouragement. "In short-story competitions, a piece will be completely rejected for having the kind of mistakes I see all the time, but I select each chapter based on



ABOVE The dull alien invasion game Ingress



RIGHT One group novel has already been published



ABOVE Not a single Dead Drop USB drive is left in London

BELOW John Smallshaw runs alternative tours around the city

its content and the feel of the writing,” she says. “Some of the best chapters have come from total beginners with no prior writing experience.” So, no pressure then.

The novel I’m taking a crack at is called *Ambition* and features assassins, spies, duplicity and death in the 1920s. My chapter takes two days to write and, by the time I’m done, I’ve added a couple of twists, a brand-new bad guy and a very gory death scene for a character I’ve named Michael – in honour of my Ingress abandoner. I fire it off to Laura with a huge grin on my face. Writing a story isn’t the same as having a great story to tell, but I’ve still had a whale of a time doing it.

Against the wall

This is it, my last tech weekend and my last chance to find a great story. I’m awake at 7am on Saturday, formatting the hard drive of an old laptop. It’s coming out of retirement to help me take part in Dead Drops (deaddrops.com), a global file-sharing project started by Aram Bartholl in 2010. It encourages people to leave art, poetry and fiction on USB drives cemented into walls around the world. The idea is that strangers like

myself can then turn up to download the contents and share their own creations. The website lists six of these drop points in London, including two in Shoreditch, one in Covent Garden and three in Richmond.

This is technological catnip for me. Each drive is both a treasure hunt and art exchange – a tiny piece of human ingenuity wedged into one of the city’s nooks and crannies.

Either that or they’re riddled with viruses and porn.

Remember how disappointing Ingress was? This is worse. None of the USB drives are still there – not one. I saw no evidence they’d ever even existed in

Richmond, unlike in Covent Garden where one had quite clearly been torn from the wall. In Shoreditch, the walls themselves had been ripped down, along with the buildings they were part of.

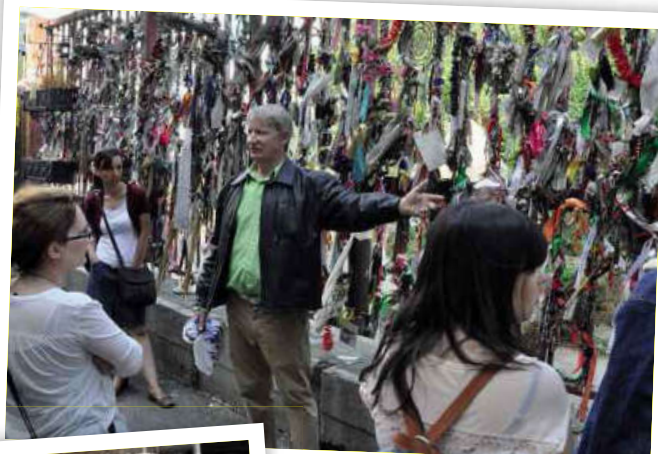
After four hours of walking, all I’ve got to show for my efforts are blisters and sadness and, by the time I approach a dishevelled chap holding the “Meet Up” sign outside London Bridge station, I’m perfectly ready to admit

defeat and slope off home. But this man is John Smallshaw: a decade ago he was a homeless heroin addict living rough around London Bridge. After getting clean, he started writing poetry and now regularly performs at the Edinburgh Fringe Festival and on Radio 4. Feeling sorry for myself in his presence is a bit like a Premier League footballer complaining about the tightness of his boots, and I quickly snap out of my malaise.

John runs tours around London Bridge, with nine of us joining him today for a walk that veers somewhat haphazardly through history, autobiography, speculation, jokes and poetry. “If I went back to being a beggar, this would be a good place to know in winter,” he says, as we stroll past a vent breathing heat into the air.

I found John through fillmyweekend.com, the most

TAKE A LONDON TOUR



self-explanatory URL you’re ever likely to come across. After signing up, you join one of the thousands of groups that match your interests – whether that’s “Gentle Walks Through London”, “The Cuddle Workshop” or “Panic Healing” (I joined the latter because I misread it as Panic Healing and thought it sounded funny). These

then populate your profile’s calendar with activities.

John’s tour is a celebration of misfits, outcasts, reformers and activists; every story is told with enough drama to keep the nearby Globe Theatre running for a year. Our tour ends with a poetry recital in Red Cross Garden, a little south of London Bridge, before a few of us decide to grab drinks and get better acquainted.

Standing in the sun with a pint in my hand, I begin to explain to them what I’ve been up to for the past three weekends. From cycling in São Paulo to waving off aliens with my smartphone, it turns out I’ve got quite a story to tell after all. ●

Alternative activities

Dozens of activities were considered for this feature, but only five made the cut. Here are a few that fell at the final hurdle, if you want a tech adventure of your own

Cuddlr

“Sometimes people just need a cuddle” is the tagline of this app, which lists nearby people willing to meet for a cuddle. No shenanigans, just strong arms and willing hearts. Cuddlr only missed out because the service fell over a few days before our trial.

Omegle

This website is Skype for strangers, letting you video-chat with random people around the world based on your interests. After much deliberation, I decided that if I wanted an awkward conversation with a potential weirdo, I’d just catch a night bus.

Protagonize

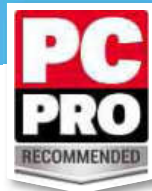
My first stab at collaborative writing was on Protagonize, a site for budding authors. I wrote the opening 600 words of a story and asked people to carry it on. At the time of writing the feature no-one had bothered, though it’s since picked up a little traction.



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Save time online and at home with IFTTT

IFTTT – If This Then That – is a free service that connects together a huge range of devices and systems. **Darien Graham-Smith** discovers how it can make your life easier

We're all connected to a bewildering range of digital services. Family members share their news on Facebook; colleagues set up meetings in Outlook; friends post photos on Instagram and Flickr. Our personal interests lead us to blogs and discussion forums. Keeping up with it all is a real challenge.

IFTTT is a free automation service that helps catch what's important. Using simple "recipes", you can set it to do things such as send you a notification when a particular person posts on Facebook. You can make it automatically add new Outlook events to your Google Calendar, or vice versa. You can get an alert when something you're interested in is mentioned on a blog, or when a particular item is posted for sale on eBay. In short, you can stop trying to keep on top of everything that's happening online – an impossible task – and leave the hard work to IFTTT.

More than 200 services are supported – IFTTT calls them "channels" – with new ones coming online all the time. And as new types of channel appear, so the service's capabilities grow. As we detail overleaf, IFTTT is increasingly hooking into real-world devices as well as virtual services: you can use it to control and interact with a

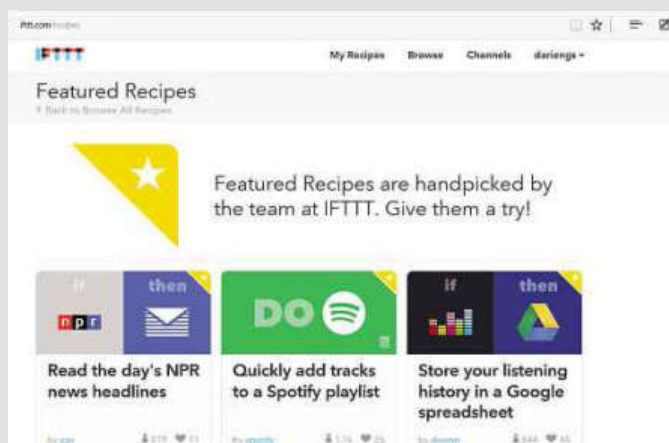
growing range of smart-home technologies, network printers and wearable devices. If you wish, you can get home-security alerts sent to your Google Glass headset to ensure you don't miss them.

Perhaps the best thing about IFTTT is how incredibly easy it is to set up. The website offers hundreds of pre-rolled recipes that you can install and activate with a single click, as we detail below. Or, if you're feeling more ambitious, you can wire up your own custom actions in moments, using the simple condition-trigger logic that gives IFTTT its name.

Recipes can also be triggered by timers as well as online events, so you can use IFTTT to carry out recurrent tasks. And in addition to traditional "IF" recipes, you can create what IFTTT calls "DO" recipes, which you trigger yourself from a smartphone app – see p56 for more details. Although the IFTTT approach focuses on simplicity, it adds up to a powerful and flexible system. No matter what services you're using, there's a good chance that IFTTT can speed up and simplify your online life.

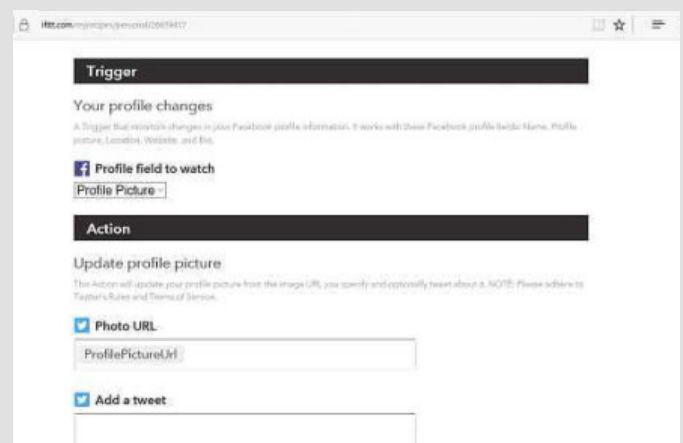


Activate your first recipe



1 Although IFTTT has apps for Android and Apple devices, the website is the best place to sign up and configure your recipes. To get started, visit ifttt.com and click the "Sign up" button to create an account (you can't miss it – it takes up half of the screen).

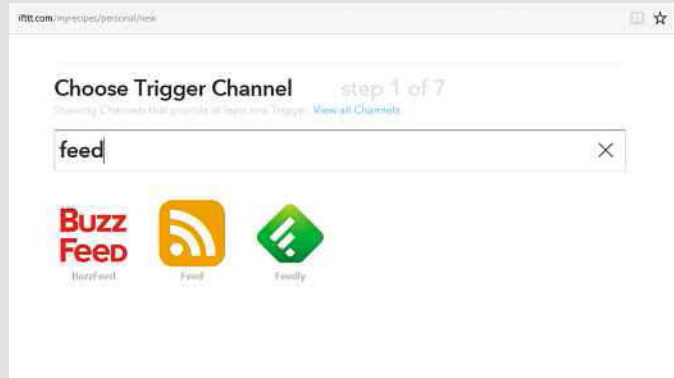
Once you've done this you'll find yourself at the welcome screen, where you can browse a variety of recommended recipes. IFTTT users have been creating and sharing these recipes for years, so there are thousands to choose from, and it's very likely that you'll find something useful. If none of the featured recipes takes your fancy, you can use the Search field to look for specific functions. Or, you can create your own recipe – we show you how on the opposite page.



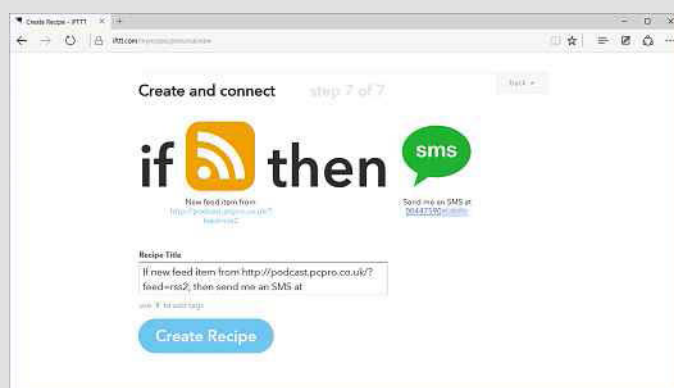
2 Once you've chosen a recipe, you'll be prompted to connect the channels it uses: normally this means entering your passwords to authorise IFTTT to access the relevant services. You can disconnect a channel at any time from the IFTTT website, or you can go into the service itself and revoke IFTTT's authorisation from that end.

You can then review the details of your chosen recipe. We've chosen a recipe that's triggered when your profile picture changes on Facebook, and updates your profile on Twitter to match. Click the Add button at the bottom of the page to add it to your account: it will be active immediately. You can do this with as many recipes as you like; to see all your active recipes (and edit or disable them) click My Recipes at the top of the page.

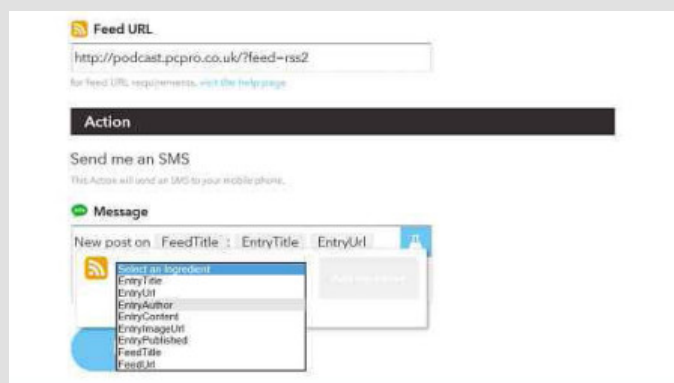
Create your own recipe



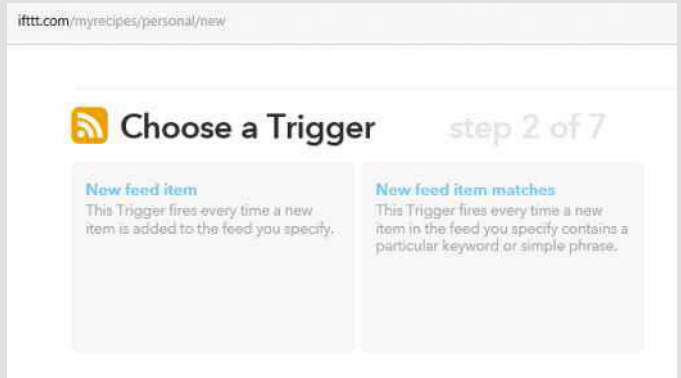
1 If you want to create your own recipe, you'll find the option under My Recipes at the top of the site. As an example, let's make IFTTT send us a text message each time a new episode of *PC Pro's Technology Podcast* is published. The wizard begins by asking which channel to use as the trigger: we'll use the Feed channel to monitor the RSS feed where podcast episodes are announced. You can use the search feature to find it quickly.



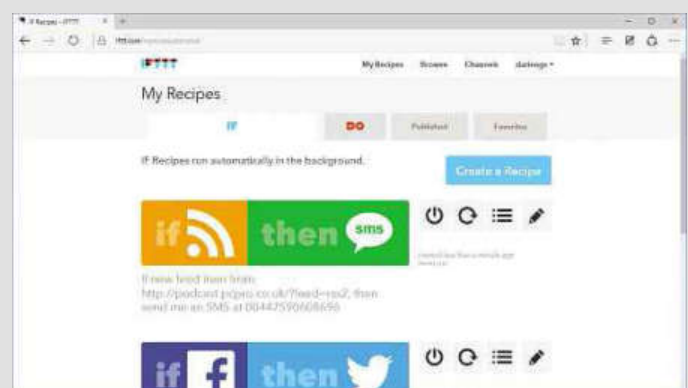
3 The next step is to choose an action channel. We've selected the SMS channel: if you haven't already connected this to your IFTTT account, you'll be prompted to confirm your phone number. SMS alerts are free, although if you receive too many in a month they may be temporarily suspended. When your recipe is finished you'll see a summary page like the above. If you're happy, click Create Recipe.



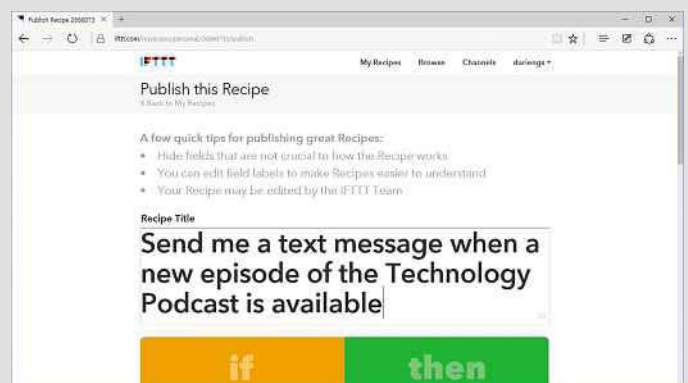
5 If you choose to edit a recipe, you'll see a page similar to this. Here the Action field shows you a preview of the SMS that will be sent when a new RSS article is posted; you can edit it by typing in text, or inserting "ingredients", which will be passed from the trigger channel. To do this, simply click the beaker icon in the top right of the text field and choose from the available parameters.



2 The Feed channel lets us choose between two different triggers: it can fire every time a new item is posted, or it can activate only when an article matches a specific search term. We want to know about every episode, so we can select the "New feed item" trigger. In the next step we'll be prompted to enter the address of the RSS feed to monitor: for our podcast this is "http://podcast.pcpro.co.uk/?feed=rss2".



4 All the recipes you activate (whether created by you or someone else) appear under My Recipes, split into IF and DO tabs (see over). The buttons next to each IF recipe let you temporarily disable it, run it right now – IFTTT says that most triggers are checked every 15 minutes – and check its log, so you can keep track of what it's done for you. The last icon (the pencil) lets you edit the recipe's settings.



6 IFTTT is a sharing platform, so why not publish your new recipe for others to use? To do this, click to edit the recipe, then click Publish. You'll be prompted to give your recipe a snappy name and description – and then it goes live. Later on, you can click on the Published tab under My Recipes to see how many people have installed your recipe, and how many have marked it as a favourite.

Connected personal technology

When IFTTT was founded in 2011, it was primarily used for keeping up with public services. Since then, however, it's gained a second string to its bow, as a system for managing personal devices and services. "Connected home" is now IFTTT's largest channel category, supporting 54 different services and devices.

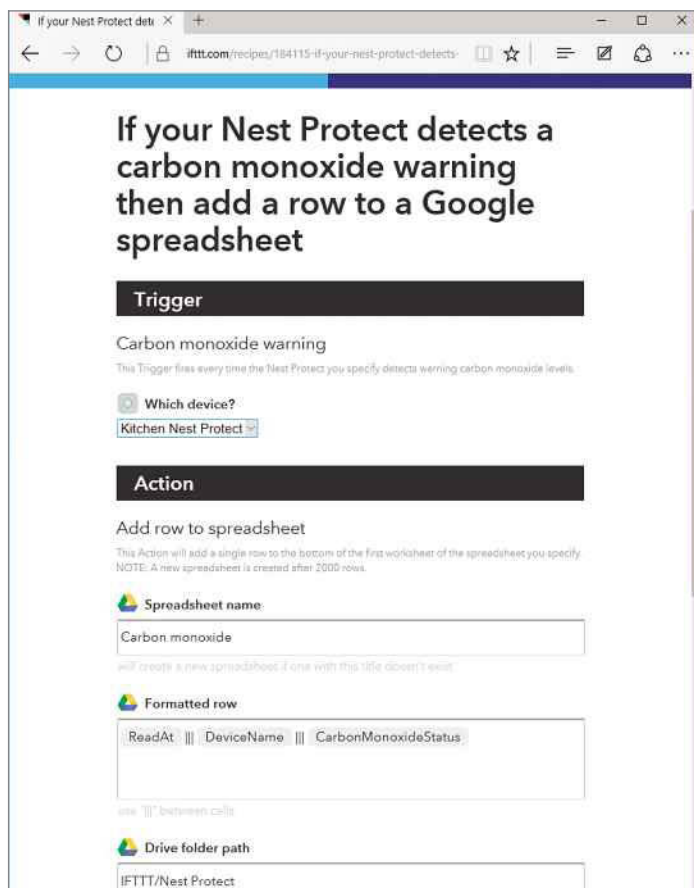
If you've started to invest in smart technology for your home, this could be IFTTT's killer feature. So far, the market for Internet of Things technologies has been held back by a lack of universal standards: the gadgets you buy for your home can't be relied on to work together.

IFTTT can bridge the gap. For example, if you invest in a Homeboy IP camera, you can use IFTTT to trigger it when your Nest Protect home alarm registers a safety event, so you can capture valuable footage of emergencies in your home, and monitor them from afar if need be. IFTTT triggers can also include location services from

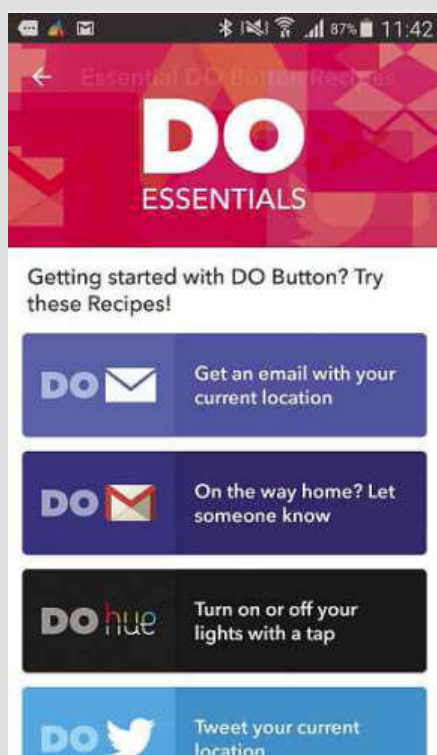
your Android or iOS phone, so you can create location-based actions that trigger switches, lights and more.

Another aspect of IFTTT that's grown in recent years is its ability to interface with fitness devices. As with smart-home technology, the industry has been held back by a lack of standards: once again, it's IFTTT to the rescue. Currently, channels from Fitbit, Nike+ and Jawbone support recipes that trigger when you meet your activity and sleep goals on the manufacturers' respective fitness devices. The Fitbit and UP channels also let you log information such as weight readings into the native app.

The Withings channel, meanwhile, ties into the company's body analytics devices, and lets you record and keep tabs on your pulse, blood pressure and weight. And for dog lovers, the Whistle channel connects to a smart canine tracker, which records whether your best friend is getting the right amounts of activity and exercise. ●



Automation on the go: DO apps



1 IFTTT's DO recipes add an extra dimension to the service, letting you trigger actions on demand from your mobile device. To use them, you simply need to install one of the IFTTT DO mobile apps, available for Android and iOS.

The simplest of these apps is DO Button. Once you've installed it, you'll be presented with a large selection of pre-rolled recipes that you can add to your profile – or you can browse all the available channels and configure your own recipes. (You can also find and create DO recipes from the IFTTT website, although you need your mobile device to use them.)

DO Button recipes let you trigger simple, recurrent actions – such as sending emails and tweets, recording events or creating calendar entries – by simply tapping the relevant button inside the DO Button app.

For faster access, you can alternatively create a DO widget directly on your Android homescreen, or in the Notification Centre in iOS. On Android it's also possible to activate floating buttons that appear on top of your homescreen and apps, so your DO actions are never more than a tap away.



2 The DO Camera app lets you create multiple camera shortcuts that each do something specific with the images you take. For example, you can launch a recipe that opens the DO Camera and automatically sends each picture you take to a particular Dropbox folder, or uploads the images you capture to a specific Facebook album. If you regularly take pictures for different purposes, it's an effortless way to keep everything organised.

It's also worth mentioning the DO Note app, which does a similar thing with text entry: you can use it to quickly create calendar events, post status updates, add items to a shopping list or even add tracks to a Spotify playlist based on a title and artist search.

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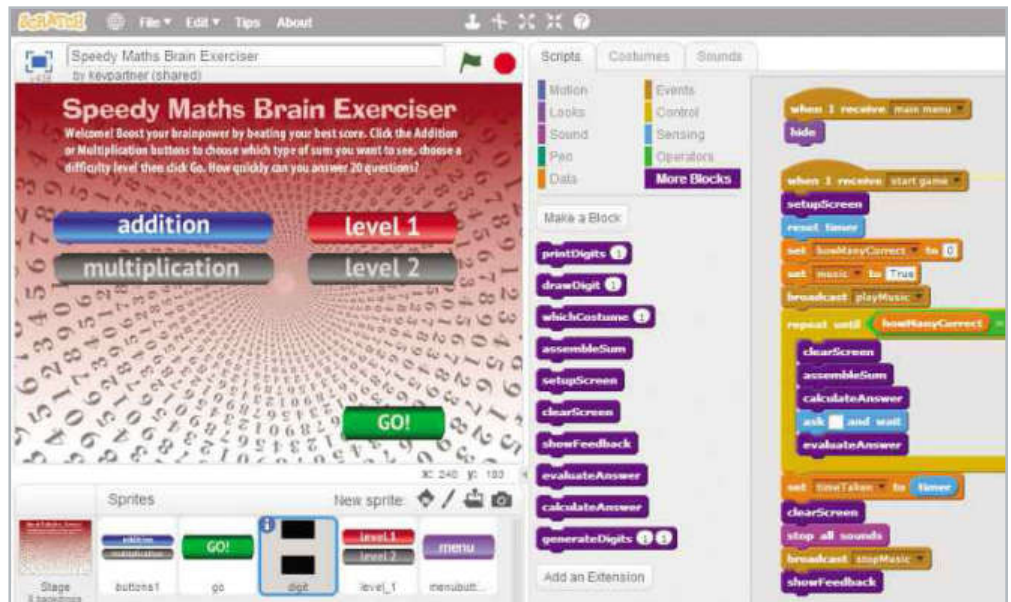


PROGRAM WITHOUT CODE USING SCRATCH

After overcoming some initial scepticism, **Kevin Partner** discovers that drag-and-drop programming isn't just for kids



Kevin Partner is an author, web developer and Raspberry Pi fan
@kevpartner



The graphical Scratch system (scratch.mit.edu) is a great introduction to programming. One of its strengths is that it teaches the principles of structure separately from any commands or syntax. Understanding how to divide code into large-scale blocks is a huge help when it comes to learning other languages: Google can show you how to put together a while loop in (for example) Python once you know that's the structure you want to use. And with the release of Scratch version 2, which adds custom functions, cloning and extensions, it's no longer just for kids.

Scratch is browser-based, so it works across Windows, Mac, Linux and Chrome OS. However, version 2 is based on Flash, which doesn't work on the Raspberry Pi, so that platform is stuck with version 1.4.

Let's look at how it works. As an example of a Scratch 2 application, I spent a few hours creating a "Speedy Maths Brain Exerciser" which you can find at pcpro.link/253scratch. Click the blue square icon to make it full-screen, then give it a go. Once you've finished the game (tweet your best score with me @kevpartner) and returned to the main URL, click the

See Inside button to launch the Scratch Editor and follow along. I recommend you register with Scratch, as this allows you to copy public projects and make your own modifications using the Remix button.

Scratch Editor has four main sections: a menu bar at the top, a preview and editing window at the top left, the sprite library at the bottom left and the block editor on the right. Within the block editor, the block library is on the left, with categories such as Motion, Events and Sensing. You create programs by dragging blocks from the library to the area on the right-hand side.

If you've just loaded the game in the editor, you'll see that the first sprite (the addition/multiplication button) is selected in the sprite pane, and three groups of blocks are shown on the right – these are the blocks attached to that sprite. A sprite is a graphical element containing one or more "costumes", which you can think of as animation frames. My addition/multiplication button has two costumes – one that shows the addition button active and multiplication greyed out and the second showing the opposite. Click the Costumes tab at the top centre to see the images.

ABOVE Scratch has evolved into an excellent platform for learning the basics of programming

"Understanding how to divide code into large-scale blocks is a huge help when it comes to learning other languages"

The blocks attached to the addition/multiplication button are triggered by an event. The first activates when it receives a message saying that the main menu is to be loaded, at which point it sets the buttons to their default state and shows them. The second hides the buttons when the game starts. The third toggles between the two graphics when the user clicks them, and sets the game type accordingly. What's wonderful about Scratch is that you can understand all this simply by looking at the blocks – you

don't need any knowledge of programming syntax.

In a Scratch program, almost all the code is attached to sprites – the code for beginning the game, for example, is attached to the

Go sprite rather than in a main script. This can make it hard to work out how someone else's project works unless they've structured it very carefully or added comments. But it introduces the idea of compartmentalising code, which is invaluable if you want to go on to learn object-oriented programming.

In this case, the bulk of the code is contained in the sprite called "digit".

This is because most of it relates to the display of numbers and symbols: click this sprite and the right-hand panel will fill with groups of blocks. It looks complicated, but for now you only need to think about the group labelled “Main Loop”, which is the main sequence of the game.

The first block says “when I receive start game”. This is what’s called an event listener: the “start game” event is broadcast by the Go button when clicked. Below the event listener is a purple block called setupScreen. This is an example of a custom block – if you click More Blocks under the Scripts tab in the middle of the page, you’ll see the complete set of custom functions I’ve created for this sprite. By creating custom functions, you can group blocks so they make sense to you – I suspect you’ll immediately recognise the purpose of each of mine. You can also use them to create standard modules, which you can use in different sprites by copying them to the Backpack at the bottom of the Edit page.

■ Costume change

In our program, you’ll see a group of blocks directly below the main loop that defines what the setupScreen function does. It’s pretty simple – it changes the background graphic to the one used for the game and then switches the costume of the digit sprite to a blank one, making it invisible. The digit sprite can also be set to a numeral 0-9, along with a decimal point and mathematical operator symbols: you can see these by clicking the Costumes tab when digit is selected. (I’ve set it up this way because Scratch lacks a method of writing text directly onto the screen.)

Moving down the main loop, we reset Scratch’s built-in timer before setting the variable howManyCorrect to zero. You can view all the variables I’ve created for this project by clicking Data in the Scripts tab. Scratch version 2 added support for list variables (also known as arrays) which you can see beneath the standard variable blocks: two of the three lists I’ve defined set the upper and lower limits for addition and multiplication. To change the difficulty, simply click the tickbox next to the list’s name to open a floating panel containing its values, then click and type to change them.

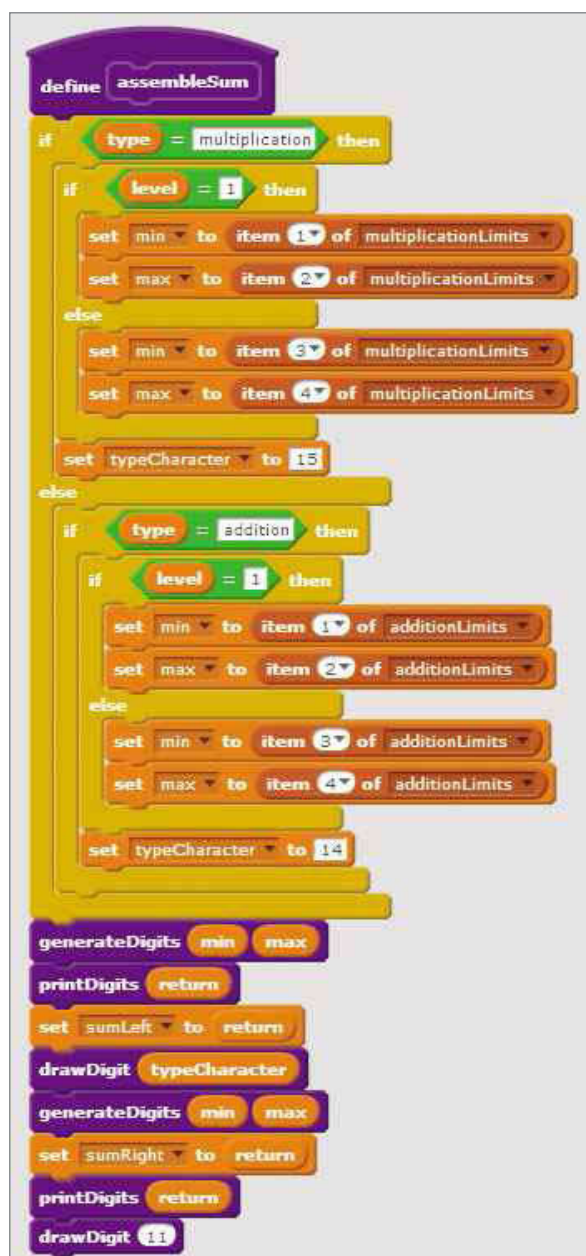
We now arrive at a repeat until loop, which is one of the blocks in the Control section. Scratch has two main control structures: repeat and if-then. You can use one of the forms of repeat to make something happen until a specified condition is met: in this case, the following blocks cycle until the number of questions answered

correctly equals the target number of questions. I’ve set this to 20, but you can change it by editing the howManyQuestions variable.

The repeat block triggers four custom blocks. Most of the work is done by assembleSum so let’s look at that. This custom block begins with an if-then-else structure that sets the lower and upper bounds of the calculation. To assemble structures like this, you begin by placing the if-then-else block, then go to Operators and drag the equals comparator onto if-then-else. Finally, drag your variables into place: no typing needed.

The block immediately following the if-then-else structure calls the generateDigits function, which uses the “pick random” block to choose a number in the range given. The custom block printDigits cycles through each digit of the number

BELOW The assembleSum custom block does all the hard work of working out and displaying the calculation



and sends that single digit to drawDigit. We’re able to use one sprite to show multi-digit numbers by creating a clone of the sprite for each digit, and setting the costume of that clone to the number needed. The costume change is accomplished in the whichCostume block: if the number fed in is 0-9, the block changes the costume to that digit. If it’s over 9 it must be a maths symbol, so the else part of the block looks up which to show by cross-referencing with the list variable costumes.

Moving back to the main loop, you’ll see that once assembleSum has completed, we call the custom block calculateAnswer, which works out the correct answer. It’s followed by an ask block, which pauses the program and waits for input. Once an answer has been entered, the evaluateAnswer block checks whether it was correct and, if so, increments the howManyCorrect variable. Once 20 questions have been answered correctly the repeat loop ends, the variable timeTaken is set to the value of the built-in timer and the feedback is shown – reusing the printDigits custom block to show how many seconds the player took.

■ Next steps

As it stands, this is a pretty basic game. It could easily be expanded with the addition of extra difficulty levels, or by including subtraction and division. For subtraction, you might want to ensure that the right-hand value in the calculation is smaller than or equal to the left: this can be achieved simply by swapping the left and right sides if necessary. For division, you’d probably want the answer always to be a whole number: the simplest way to achieve this is to multiply two numbers and use the product and one of the multipliers to create your division sum. You could also polish it by showing the current score throughout, improving the graphics, adding special effects or altering the scoring system – feel free to have a go, and please do share the results with me.

I was sceptical about the value of Scratch when I first encountered it; having spent time using it to create a complete project, I’ve revised my opinion. In my view it’s the best choice for children to start learning programming, and a good option for adults too. Its increasing sophistication makes it possible to create advanced projects – the most impressive I’ve seen is 2D Minecraft ([pcpro.link/253scratch2](https://www.pcp.pro/link/253scratch2)) – and get a head start on learning more traditional languages such as Java or Python. ●

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The GW-HTX30 marks a giant leap forward in performance thanks to having two 8-core Intel Xeon E5 2640 V3 CPUs. These are partnered with a 4GB NVIDIA Quadro K4200 professional graphics card and 64GB of 1600MHz ECC Registered DDR3 plus a 240GB SSD and 2TB HDD.



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The LG1520 is a 15.6" high-end gaming laptop that includes a choice of powerful NVIDIA GeForce GTX 970M or 980M graphics card, ensuring silky smooth frame rates in all games. The LG1520 is ready for next-day delivery and has a 2 Year Warranty.



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3XS SYSTEMS

Reviews

The biggest, best, most exciting products in tech – tested, evaluated and reviewed

Samsung Galaxy S6 Edge+

Samsung's oversized Galaxy S6 Edge+ is a rare beauty, but expect it to blow a crater in your bank balance

PREVIEW

PRICE 64GB, £583 (£700 inc VAT); £99 on a £41/mth, 24mths contract from expansys.com

Sometimes all you need is good looks. The Samsung Galaxy S6 Edge isn't quite that shallow, but its seductive curves certainly catch the eye. Its larger sibling, the Samsung Galaxy S6 Edge+, has just been unwrapped by Samsung in New York, and provides more substance to the world's sexiest smartphone.

I'll start with the basics. The Samsung Galaxy S6 Edge+ is a larger version of the Galaxy S6 Edge. It's clad in glass at the front and rear, and uses Gorilla Glass 4 to prevent scratches and more serious damage. The camera unit at the rear sticks out, just like the S6 and S6 Edge, and the twin curves either side of the main display remain in place, surrounded by a matte-silver frame.

Its Super AMOLED screen measures 5.7in diagonally, with a Quad HD (2,560 x 1,440) resolution (just like the Galaxy Note 4 from last year) and it's ludicrously sharp, with an ultra-high pixel density of 518ppi.

Embedded in the slim metal frame you'll find the phone's buttons and ports. The volume controls are on the sliver-thin top-left edge, with the power button on the opposite side. The 3.5mm headphone jack and micro-USB charging port are on the bottom edge next to the single speaker grille, while the phone's nano-SIM slot is located on the top edge.

It's a gorgeous handset, but those hoping that Samsung might bring back the microSD slot will be



disappointed: just like the S6 and the S6 Edge, there's no easy way to get inside the phone. You can't replace the battery, and there's no way to expand the storage.

However, Samsung has made a couple of hidden improvements to the phone's design, claiming a 1.7x increase in structural strength over the S6 Edge, and a 1.3x improvement in scratch resistance.

But what's really impressive about the S6 Edge+ is how compact

it feels in your hand, despite its enlarged dimensions.

■ The bleeding Edge

When it comes to features, the key thing to note is that the S6 Edge+ isn't part of Samsung's Note family. Although Samsung has launched it alongside the Samsung Galaxy Note 5, it has no S Pen stylus. Instead, the key feature is the twin-edge design. In addition to being able to set up a number of favourite contacts and call or message them, it's now possible to send "pokes" and emoticons directly from the Edge screen – although this feature only works with other Samsung phones.

Not convinced yet? Swipe across the edge, and you'll find the secret weapon: the Apps Edge. Here you can add shortcuts to your favourite apps, to access them with a quick swipe and tap. This is a feature you may remember from the Samsung Galaxy Note Edge, but there's no sign yet of that phone's extra enhancements. The Note Edge featured not only contact and app shortcuts, but extra edge screens, from a ruler to a stopwatch. Samsung even put camera and music controls on its original Edge screen.

■ Performance and specifications

Although I haven't had an opportunity to run any benchmarks yet, I expect a similar set of results to the S6 and S6 Edge.



That's because it shares a core set of features. The main power behind the phone is the same 14nm Exynos 7420 octa-core SoC, comprising twin quad-core CPUs running at 2.1GHz and 1.5GHz.

Alongside this powerhouse is 4GB of LPDDR4 RAM – a smidgen more than in the smaller S6 Edge – and either 32GB or 64GB of storage. The battery will be a larger 3,000mAh unit (the S6 Edge has a 2,600mAh battery). Whether or not this leads to longer run times is unclear, but, given the larger screen, I suspect that the S6 Edge+ won't last a great deal longer than its smaller siblings.

Despite the larger battery, the phone should charge up quickly. Due to improvements in



wireless charging hardware, Samsung says the Galaxy S6 Edge+ will charge 27% faster than the S6. It also hasn't neglected the wires, with the new handset taking only five minutes longer to reach 100% on the battery gauge when charging via USB.

In terms of wireless connectivity, the S6 Edge+ now supports up to Cat9 4G (450Mbps/sec download speed) on compatible networks, has dual-band 802.11ac Wi-Fi with 2x2 stream MIMO, plus ANT+ and near-field communication (NFC).

The phone retains the fingerprint reader from the S6 line of phones – so once Samsung Pay is firmly in place later this year, you'll be able to use the phone to pay for public transport in London, and for purchases below £30 in shops. One advantage the S6 Edge+ has over Apple's iPhone 6 and 6 Plus is that retailers don't need an NFC-capable card reader. Samsung's magnetic secure transmission (MST) allows you to pay by simply holding the phone to the mag-stripe reader on any payment terminal.

Samsung hasn't introduced any new camera technology with the S6 Edge+: it has the same rear 16-megapixel camera and front 5-megapixel camera as the S6 and S6 Edge. With the combination of optical image stabilisation, a large f/1.9 aperture and hybrid phase/contract-detect autofocus, I fully expect it to

match its smaller cousins for quality.

■ Software upgrades and accessories

However, Samsung has introduced some new camera features via software, notably a video digital image stabilisation system (VDIS). This adds stabilisation to the front and rear camera, and introduces face tracking. The phone also has automatic video-editing modes, including Collage and Series, and Samsung is introducing a live-broadcasting feature in its camera app, based on YouTube's technology.

There's also 24-bit/192kHz audio upscaling for your MP3s, improved audio hardware, and support for Samsung's new Bluetooth codec – UHQ – for better audio quality over wireless headphones. The phone will also run Samsung's TouchWiz launcher software, this time on top of Android 5.1.1 Lollipop.

Finally, Samsung's new SideSync 4 desktop software includes automatic wireless connection over your local Wi-Fi network.

There's even a natty keyboard case that makes the S6 Edge+ look like a giant BlackBerry. Keyboard warriors and BlackBerry lovers (there must be some left, right?) shouldn't get too excited, though – some keys weren't 100% responsive, needing to be stabbed a few times before the letters appeared onscreen.

■ Preliminary verdict

The Samsung Galaxy S6 Edge+ is a fantastic piece of hardware. It

looks as good as the S6 Edge, and by minimising the bezel and shaving weight off the handset, Samsung has delivered a device that's about as small as you could imagine for a 5.7in screen.

Combined with Samsung's camera technology, a large 3,000mAh battery and a plethora of features, you have a killer combination. The only problems are the lack of microSD slot and the price. The 64GB version is £700, with the 32GB version available for a pricier £749. Contract prices are equally high, at £41 per month with an upfront fee of £99. That definitely doesn't stop me wanting one, though. **JONATHAN BRAY**

"You'll be able to use the phone to pay for public transport in London, and for purchases below £30 in shops"



Motorola Moto G

Motorola does it again: the third-generation Moto G is packed with top-rate features at a bargain price

SCORE ★★★★★

PRICE SIM-free, £133 (£159 inc VAT)
from motorola.co.uk

Admit it: you pay too much for your smartphone contract. What is it? £40 per month? Over two years you could pay nigh on £1,000 for the privilege of owning a high-end smartphone. The third-generation Motorola Moto G costs £159 SIM-free, and it may well be all the smartphone you need.

The first Moto G was a revelation in 2013, and this third-generation model sticks to the fundamentals: it's cheap, robust and well made. That's not to say there haven't been improvements. The curvy design is more enticing than before, with hints of the Nexus 6, and the rear shell is now textured for grip. A contrasting strip encircles the camera, flash and Motorola logo.

There are two colours to choose from – white with a silver frame, or black with a black frame – and the rear shell is available in lime green, black, navy blue, wine red, yellow, blue, turquoise, red or white. For an extra £20, you can specify the colour of the camera and logo surround, add an engraving to the rear and even add a message to the phone's startup screen.

The phone's accident-proofing has been beefed up too: a couple of rubber seals on the underside of the shell surrounding the SIM and microSD slots help the phone achieve an IPX7 rating. That means it can be immersed in up to a metre of water for up to 30 minutes, making it possible to shoot underwater photos and videos.

The processor has been upgraded too, from the Qualcomm Snapdragon 400 to a newer quad-core chip, the



1.4GHz Snapdragon 410 – as in the recent Moto E. The standard 8GB model has 1GB of RAM, while the 16GB version (£209 online) gets 2GB.

What does that mean for performance? The 2GB model I tested completed the SunSpider benchmark in an average of 1,331ms, while in Geekbench 3 its single- and multi-core scores were 529 and 1,576. These are up 32%, 54% and 36% respectively over the 4G Moto G 2.

Gaming doesn't benefit: the Adreno 306 GPU averaged only 10fps in the GFXBench T-Rex HD test at native resolution and 4fps in the Manhattan test; the Moto G 2 with 4G achieved 11fps and 4fps. Still, while it's not for the latest games, it flies with everyday tasks, feeling much more responsive than its predecessor.

The display is still a 5in, 720 x 1,280 IPS screen, with scratch- and shatter-resistant Gorilla Glass 3, and image quality can't be faulted:

brightness hits 408cd/m², the measured contrast ratio is 1,134:1, and everything looks bright and punchy. A polarising layer helps minimise the sun's glare too.

Battery life is fine, if not outstanding. The Moto G's 2,470mAh battery reliably got through the day with

LEFT The new camera is a big step up from the old model

ABOVE The curved, two-tone design adds a note of style



"The Motorola Moto G flies with everyday tasks, feeling much more responsive than its predecessor"

+ Great build quality; features to rival phones twice the price

- Can't handle high-end games; base storage is limited; Wi-Fi is single-band only

capacity to spare: streaming audio over 4G with the screen off depleted battery life at a rate of 4.5% per hour, and video ran it down at 7.4% per hour.

At last 4G is standard, but the Moto G still lacks dual-band Wi-Fi – an almost criminal omission in 2015. And while you can expand storage via microSD, only cards up to 32GB in size can be used.

Another major upgrade is the camera, which is inherited from the Nexus 6. Although the Moto G lacks optical image stabilisation, it's a huge step forward from the old 8-megapixel camera, producing crisp and colourful images. It's much faster too: tap the screen and there's no longer a momentary lag

while the shutter catches up.

As for audio, the front-facing stereo speakers remain excellent – ideal if you use your phone as a satnav in a car without a Bluetooth-enabled stereo system – and I had no issues with call quality during testing.

The Moto G's Android front-end is unencumbered by fussy launchers, and what Motorola has added works well. The new "double-chop" gesture, used to switch on the torch, is sheer genius, and the phone inherits the excellent Moto Display feature from the Moto X too, which shows notifications in circular bubbles on the standby screen.

In all, Motorola has nailed it once again with the third-generation Moto G. Its upgraded internals make it more responsive, and the software makes it feel more like a flagship

than a sub-£200 device. Before you upgrade your phone, you really should consider the Motorola Moto G. It's the best budget smartphone on the market, and well worth the asking price. **JONATHAN BRAY**

SPECIFICATIONS

Quad-core 1.4GHz Qualcomm Snapdragon 410 SoC • 1GB/2GB RAM • 8GB/16GB storage • microSD slot (up to 32GB) • 5in, 720 x 1,280 IPS display • 13MP/5MP rear/front cameras • single-band 802.11n Wi-Fi • 4G • 2,470mAh Li-ion battery • Android 5.1.1 (Lollipop) • 1yr RTB warranty • 72 x 12 x 142mm (WDH) • 154g



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- PC Pro



Nokia N1

A near-perfect Android tablet, but without an official UK supplier it's hard to recommend

SCORE ★★★★★
PRICE Around £200

It's not often that we review products without an official distributor in the UK – but the Nokia N1 tablet is a worthy exception, and grey importers and eBay sellers mean you can get one for around £200, if you really want.

Normally, I wouldn't recommend this as a route to buying a product. Unless you're purchasing it from a reasonably reputable importer, the chances of getting a refund if it's faulty are minimal. Service and support will be hard to come by, and you'll have to deal with rough edges such as non-UK power adapters.

That said, the N1 is still an attractive prospect. It's not only one of the nicest-looking Android tablets I've seen, it's probably the best. It's good enough to make me think that it could win over people who started off wanting an iPad.

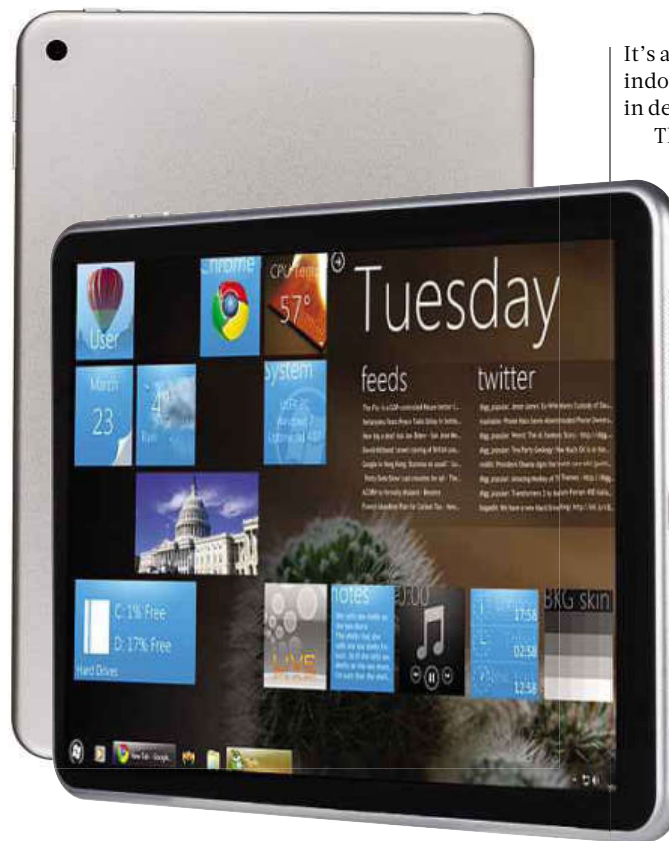
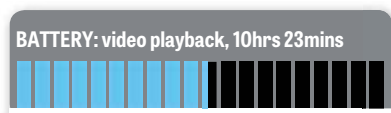
It helps, of course, that it looks like an iPad. The screen specs are identical to the iPad mini 3, with a 4:3 aspect ratio and incredibly sharp 7.9in, 2,048 x 1,536 display. It hits 410cd/m² at maximum brightness, with superb colour accuracy and excellent contrast. The case is well-engineered aluminium, and the curved edges remind you immediately of Apple's devices.

My only quibble over the physical design is that it feels a little top-heavy when held in portrait mode. Nokia has attempted to evenly distribute the weight throughout the body, but this makes it feel a little heavy. This is a tiny detail, though.

Internally, the N1 is very different from the iPad, and most other Android tablets. Rather than go down the ARM route or use a slow Atom, the N1 employs one of the latest quad-core 2.3GHz Intel Atoms (the Z3580).

This makes it fast: we had no problems running graphically

RIGHT The Nokia N1's curved edges immediately remind you of Apple products



intensive games on it. Benchmarks reveal that it isn't the fastest tablet around, however, with a 26fps result in the GFXBench T-Rex onscreen test, Geekbench 3 results of 874 in the single-core test and 2,585 in the multi-core test. This places it behind the Nexus 9 and Sony Xperia Z4 Tablet.

The 5,300mAh battery will give you whole-day performance: in heavy everyday use, it happily lasted two days between charges. In testing, the N1 looped a 720p video, with the screen set to a brightness of 120cd/m², for 10hrs 23mins, which is good, if not the best.

There's 32GB of storage as standard, but not all of that is available for use: I had just under 24GB of space available without installing anything. There's also no microSD slot, so that's all the storage you're going to get. Still, this is more than you'll get from the entry-level, and similarly priced, iPad mini 2.

Nokia has always been famous for its quality cameras, but the N1's rear 8-megapixel sensor isn't very good.

ABOVE The display is very sharp, and the colour accuracy and contrast are superb

"The good news on the software side is that Nokia has very wisely kept the N1 close to stock Android 5.0.2"

+ Lovely design; great screen; excellent performance; almost-stock Android
- Availability in the UK is uncertain

It's adequate outdoors, but indoor pictures are grainy even in decent light.

The good news on the software side is that Nokia has wisely kept the N1 very close to stock Android 5.0.2. There's no bloatware or attempts to "improve" Google's own apps, meaning it's a pleasure to use. The big feature Nokia has added is the Z Launcher homescreen. Although this looks very much like stock Android, there's a significant difference: you can use your finger to write a letter, and it displays apps, bookmarks and contacts beginning with that letter.

At first, I thought this was a gimmick. However, it grew on me and I came to find it a speedy, intuitive way of getting around. Want to access your settings? Simply scrawl "s" followed by "e". The recognition engine isn't perfect, and I found that it would get confused if I quickly followed one letter with another, but it worked reliably with a little practice.

Overall, the Nokia N1 is an excellent Android tablet. The design, performance and battery life inspire a fresh look at the whole Android tablet category. If other manufacturers want to compete with Apple, they should look at the N1 as an example of how to do so.

That just leaves the question of whether you should buy one – and this is where things get complex.

If Nokia were officially distributing it, we wouldn't hesitate to answer with a resounding "yes". Our review sample was supplied to us by a company called Colourful Tech, which was set up to import the N1, but is currently on trading hiatus to sort out a dispute with Nokia. Meanwhile, you can pick one up on eBay or via other grey importers.

But this isn't without risks, making the N1 difficult to recommend. We hope that Nokia finally brings the N1 officially to the UK, because if it does we're confident it will have a real hit on its hands – and it would be a product we'd be happy to recommend without reservation. **IAN BETTERIDGE**

SPECIFICATIONS

Quad-core 2.3GHz Intel Atom Z3580 • 2GB RAM • 32GB storage (24.3GB available) • 7.9in, 2,048 x 1,536 display • 8MP/5MP rear/front cameras • 802.11ac Wi-Fi • Android 5.0.2 • 139 x 6.9mm x 201 (WDH) • 318g

Acer Aspire Switch 10 E

Acer's 10in hybrid aims to bring both style and substance to the budget notebook market

SCORE ★★★★★

PRICE £167 (£200 inc VAT) from amazon.co.uk

Designing a desirable product on a budget is never an easy task, but Acer has certainly tried to make its latest hybrid stand out from the crowd. Available in a multitude of colours – some garish, some tasteful – the Aspire Switch 10 E is clad in distinctive rough-textured plastic that's pleasing to touch, and feels durable and rugged in the hand.

It isn't anywhere near as stylish as the HP Pavilion x2, which sets the standard in the category, but it's pleasingly compact, measuring only 262 x 180mm. With the keyboard attached it's 23mm thick, and a mere 11mm in tablet mode. It's light too, weighing 1.19kg in laptop mode, and 622g as a tablet. That's 185g more – or just under two Cadbury Dairy Milk bars heavier – than an iPad Air 2.

Open the lid and you'll find a 10.1in, 1,200 x 800 IPS touchscreen, along with a standard laptop keyboard. Around the tablet edges sit micro-USB, micro-HDMI and microSD ports, with an extra full-sized USB connector on the keyboard. Wireless connectivity comprises single-band 802.11n and Bluetooth; the bare basics, in other words.

As a laptop, the Switch is portable and easy to use. Its keyboard feels solid and comfortable to type on, if slightly spongy, and the trackpad is responsive. The 1.33GHz Intel Atom Z3735F is powerful enough to make Windows feel snappy, but with 2GB of shared RAM and 32GB of flash storage, the Switch isn't going to set the world on fire. Compared to the HP Pavilion x2, performance lagged slightly in the

image- and video-editing portions of our benchmarks, but you'd be unlikely to notice the difference. I wouldn't advise trying to run too many apps simultaneously though – not that you'd want to, as the small screen quickly starts to get cluttered.

Detaching the keyboard doesn't change the experience much, although Windows 10 failed to switch between Desktop and Tablet modes automatically, which makes changing feel clunkier than it should. Then again, the device does support four different usage modes, so perhaps a little confusion is excusable. In addition to regular laptop and tablet modes, the Switch – like Lenovo's Yoga models – lets you rotate the screen back to act as a stand, or turn the whole thing upside down into a "Tent" position. These options are rarely useful, but it's nice to have them – and impressive for the £200 price.

Battery life is respectable. In our video-playback tests the Switch 10 E lasted 8hrs 40mins, beating the HP Pavilion by an hour or so. It's not quite the best we've seen from a budget hybrid: the Toshiba Satellite Click Mini lasted more than nine hours.

The screen is slightly brighter than the HP's – I measured it at 335cd/m² – and

ABOVE The Aspire Switch 10 E makes a decent little laptop

"The Aspire Switch 10 E is clad in distinctive rough-textured plastic that's pleasing to touch, and feels durable and rugged"

contrast is slightly better too, at 1,235:1. Naturally, though, it doesn't look as sharp as the Click Mini's Full HD screen, owing to the lower resolution. The Switch's display does, however, benefit from Acer's LumiFlex and BlueLight Shield technologies. LumiFlex automatically optimises screen visibility under bright light, and BlueLight Shield reduces the screen's

blue-light emissions to reduce eye strain when using the device for long periods. While these features aren't great for colour accuracy, this isn't the sort of device you're likely to be using for

colour-critical design work.

At £200, the Acer Switch 10 E is a bit of a bargain. It's perfectly capable for those who just want to edit a document or two, or browse the web on the move; battery life is decent, and there's nothing objectionable about the hardware.

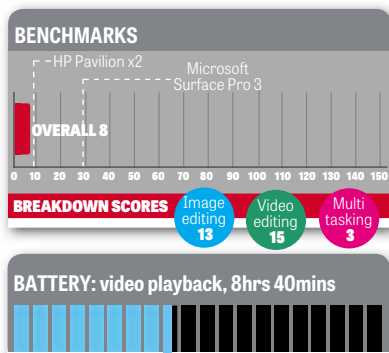
However, if you can afford to spend £20 more, I'd go for the HP Pavilion x2 instead. Its core hardware is similar, as is all-round performance, but it's packaged in a sleeker, slightly lighter chassis, and it's more comfortable to use. **VAUGHN HIGHFIELD**

SPECIFICATIONS

Quad-core 1.33GHz (1.83GHz with Burst) Intel Atom Z3735F • 2GB RAM • 32GB SSD • Intel HD Graphics • 10.1in 1,200 x 800 touchscreen • USB 2 • micro-USB 2 • micro-HDMI • microSD • 802.11n Wi-Fi • Bluetooth 4 • Windows 8.1 with Bing • 1yr RTB warranty • 262 x 180 x 23mm (WDH) • tablet, 622g; tablet and keyboard, 1.19kg

LEFT The Switch 10 E is pleasingly compact, only 23mm thick with the keyboard attached

+ Cheap, robust and very portable
- Atom processor isn't particularly powerful



Asus ZenPad S 8.0 (Z580CA)

Asus takes a swipe at the high-end compact tablet sector, but the ZenPad S 8.0 falls short in a few areas

SCORE ★★★★★

PRICE £192 (£230 inc VAT) from expansys.com

Tablets have shrunk from the limelight in recent times. What once was a richly varied, technicolour stream has slowed to a trickle – yet, despite that, it's becoming increasingly difficult for manufacturers to make their mark. The ZenPad S 8.0 sees Asus attempting to inject a little life into the compact-tablet market – and it looks like it might just be onto something. This isn't just another generic, budget Android tablet to add to the list. Instead, Asus has set its sights a little higher. With a high-DPI screen, quad-core Atom processor and a healthy smattering of features, not to mention support for an optional active stylus, Asus is confident the ZenPad S 8.0 will convince people to part with £230.

■ Design

It's not shallow to say that a premium tablet needs to look good. Here, chrome trim encircles the display, framing the narrow bezels on the edges and the inch-thick borders at the top and bottom of the screen; the rear is finished with a brushed-metal effect that's bordered on one edge by a strip of faux leather. That might conjure up some pretty horrible mental images, but it's not as bad as it sounds. The ZenPad S 8.0 has a touch of individuality to it, at least.

At 319g, this is one of the lighter tablets on the market, but this comes at a price. Since the metallic-looking rear is mere plastic, there's more give in the Asus' frame than I'd like. By comparison, the iPad mini and Nokia N1 (see p66) are absolutely rock-solid. Still, there are practical sides to the design. The strip of leather adds a little more grip where it's needed, making the ZenPad S 8.0 feel less likely to slip out of your hands.

■ Display

Asus has made one important tweak to the familiar Android tablet formula. It's adopted a 4:3 aspect ratio. That might not sound like

cause for celebration, but it is. The ZenPad S 8.0's screen feels far more usable in both portrait and landscape orientations than a tablet with a 16:9 screen. It's a revelation.

The fact that Asus has upped the display resolution to 2,048 x 1,536 doesn't hurt either. All those pixels crammed into such a tiny frame result in a super-crisp 320ppi display, and first impressions are good – images are lively and teem with detail.

Brightness reaches a decent 300cd/m² with the screen brightness set to maximum, and activating the automatic brightness sensor sees the Asus' screen pump up to 354cd/m² under bright sunlight.

Contrast reaches an impressive 1,574:1, too, but this is misleading – Asus has employed an always-on dynamic contrast feature.

Closer inspection reveals other flaws. Colours aren't as vivid as they could be, and testing revealed that the ZenPad covered a mere 77% of the sRGB colour gamut. That's very slightly better than the iPad mini 2 and 3, both of which covered 71%, but those tablets provide a much more neutral, balanced performance overall.

The Asus is disappointing by comparison. Photographs with natural skin tones and subtle shades look unnatural, and highlights are blown out. Even after tweaking the colour temperature in the Asus Splendid app, it's impossible to achieve a perfectly natural image, primarily because the dynamic contrast feature causes clunky, obvious shifts in brightness as screen content changes.

■ Performance

Inside, Intel's quad-core Atom Z3560 processor takes centre stage, and by and large it does a reasonable job of dealing with Android 5. Scrolling around image-heavy web pages can be a touch juddery – a complaint I've



had with a variety of Intel-powered tablets – but generally it feels like a snappy, responsive device.

The Atom isn't powerful enough to crush its rivals in benchmarks, though. The Asus' results of 764 and 2,343 in Geekbench 3's single- and multi-core benchmarks put it behind the iPad mini 2 and 3, as well as slightly behind the Samsung Galaxy Tab S 8.4. Only gaming offers some solace for the Asus, its PowerVR G6430 GPU gaining it a creditable 26fps in the GFXBench T-Rex HD test – slightly ahead of its compact-tablet rivals.

Battery life is a strong point, too. With a 720p movie set to loop indefinitely, Wi-Fi off and the screen calibrated to a brightness of 120cd/m², the ZenPad S 8.0 lasted 13hrs 51mins. I suspect dynamic contrast is playing its part here, as it aggressively dims the backlight during darker scenes, a trick that gives it a slightly unfair leg up on the competition.

■ Features and software

Asus hasn't adopted the latest Android 5.1 build. Instead, the ZenPad S 8.0 runs Android 5 with Asus's ZenUI customisations sitting on top. That means there's a customised notifications dropdown, and a bounty of Asus apps come preinstalled.

These include some nice additions. You can double-tap the screen

to wake the tablet, and ZenUI's Smart Folders attempt to automatically file new apps into neatly labelled folders – something that can come in handy.

The notifications dropdown is no more functional than that of stock Android, and one annoyance is that it forces you to select four of Asus' own mini tools, wasting space that could otherwise be lavished on more useful toggles than screenshots, the Asus AudioWizard settings, clearing the used memory and quickly accessing the camera.

Indeed, the amount of bloatware crammed on the ZenPad S 8.0 is faintly ridiculous – at one point,

ABOVE Asus' dynamic contrast feature makes it impossible to achieve a perfectly natural image

“Asus has set its sights high, with a high-DPI screen, quad-core Atom processor and a smattering of features”

+ Performance and battery life are competitive, and the price is reasonable

— Dynamic contrast ruins the display, and the bloatware is excessive

BATTERY: video playback, 13hrs 51mins



a notification announced 22 pending updates for preinstalled Asus apps. The last thing anyone wants on their premium tablet is a bunch of apps that they didn't install, although it is possible to remove them to free up space.

The stock Asus Keyboard isn't great, either, and although it supports Swype-style trace typing, I found it prone to typos in everyday use. Thankfully, reinstalling the Google Keyboard from the Play store only takes a minute or two.

There are other usability niggles too. For example, the fact the ZenPad S 8.0 supports an optional active stylus is intriguing (although Asus didn't provide us with one for testing), but on occasion the touchscreen didn't respond at all. I had to prod several times before it registered my inputs. This wasn't a regular occurrence, but it was annoying nonetheless; hopefully a software update will fix it.

Features

All the essentials you'd expect, and more besides, are here. The latest USB Type-C connection provides both a charging point and, with a suitable OTG cable, the ability to connect external storage and peripherals. A microSD slot makes it easy to expand the 32GB of storage, and both 802.11ac and Bluetooth 4.1 (which includes Bluetooth Smart) come as standard, too.

The pair of cameras are nothing to get excited about. Asus includes an 8-megapixel snapper at the rear and a 5-megapixel front-facing sensor, and both serve up mediocre photos. The grainy low-light mode does its bit to crank up the brightness in poor light conditions, but it's no miracle worker.

The speakers aren't much to write home about, either, and despite the efforts of Asus'

AudioWizard app, the sound is tinny and uninspiring. The only plus point is that they're front-facing, so don't get muffled by your hands.

Verdict

The Asus is far from a perfect package. The sheer amount of bloatware is ridiculous – given the choice, stock Android would make a far better choice. The display's dynamic contrast is incredibly annoying too, ruining what otherwise would be a very capable screen. And right now, charging via a USB Type-C is more of a hassle than a benefit. Until everyone has a clutch of these new cables lying around, it's a mildly frustrating novelty.

The ZenPad S 8.0's biggest problem, however, is the thing Asus can do least about: the strength of the competition. For instance, you can pick up a 16GB Samsung Galaxy Tab S 8.4 for around £270, or a 32GB iPad mini 2 for £279. With that kind of competition on its hands, the ZenPad S 8.0 simply doesn't offer enough. **SASHA MULLER**

SPECIFICATIONS

Quad-core 1.8GHz Intel Atom Z3560 CPU • 2GB DDR3 RAM • 32GB storage • 8in 2,048 x 1,536 IPS touchscreen • 8MP/5MP rear/front cameras • 802.11ac Wi-Fi • Bluetooth 4.1 • Android 5 Lollipop • 1yr RTB warranty • 135 x 6.6 x 203mm (WDH) • 319g



RIGHT The strip of faux leather at the rear adds a little more grip where it's needed

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LibreOffice 5

It's free! It's open! But does LibreOffice deliver on its promise of a powerful office suite for normal users?

SCORE ★★★★★

PRICE **FREE** from libreoffice.org

How much should you really pay for a full suite of office applications? The nightmare scenario for Microsoft is that the answer is “nothing”, and LibreOffice is one of the products intent on making that bad dream a reality.

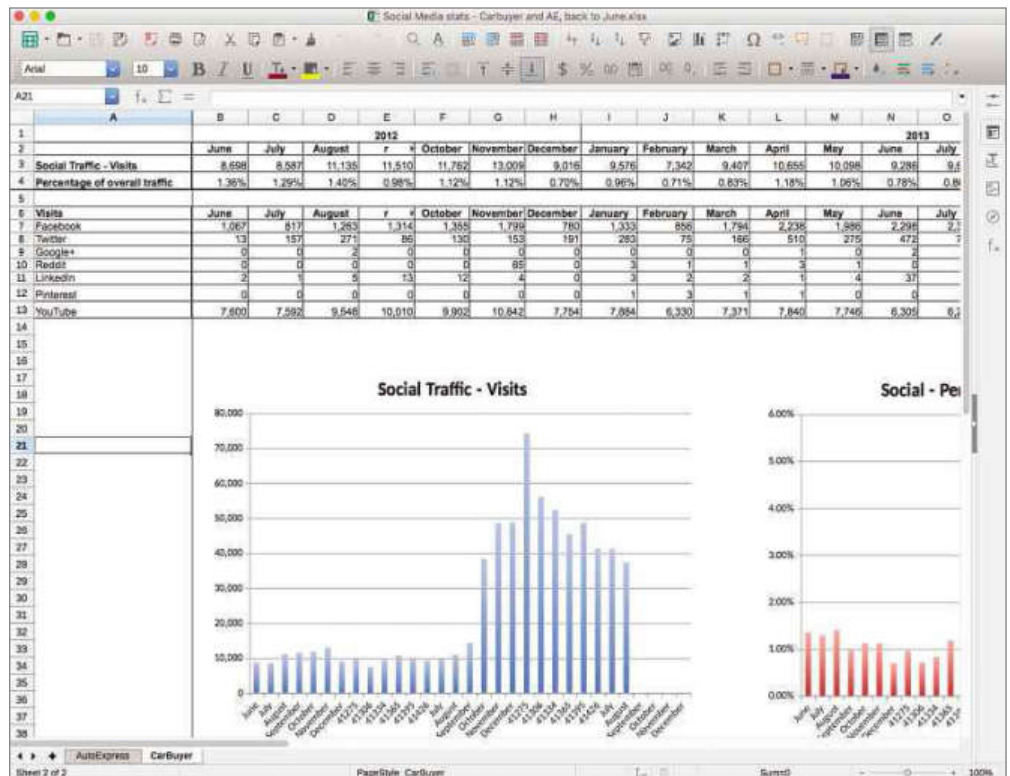
LibreOffice is a completely free, open-source office suite that includes word-processor, spreadsheet and presentation software. It's derived from the old OpenOffice codebase, but has improved upon it and its successor products. And, as you'd expect from an open-source product, it's available on a range of platforms: Windows, Linux, OS X and (of course) anything you can get the source code to compile yourself.

That doesn't include either Android or iOS, although an Android viewer lets you see documents and a full version is apparently “coming soon”. This is the first problem with LibreOffice: now that a lot of work happens on tablets and smartphones, the lack of a full version on those platforms seems antiquated. When Microsoft is creating versions of Office for both Android and iOS, having an office suite that isn't available on mobile devices is a major hindrance.

■ Design and core features

The overall look and feel of LibreOffice is also dated. Although it has been improved from older versions of OpenOffice, which really looked like they had been designed in 1998, it still doesn't match the design work and attention to detail that has gone into Microsoft's suite. It's best described as functional, rather than pretty. You might argue that an office suite doesn't need to look attractive, but for many people, using something that looks and feels dated does matter. Even the icon on OS X – a dull grey document with one corner turned over – looks uninviting.

It is, to its credit, a clean-looking interface, and one that will be familiar to anyone who used Microsoft Office ten years ago. Whether you prefer a modern look or something traditional will determine whether you like the interface design of LibreOffice.



LibreOffice eschews Microsoft's ribbon bar – with multiple tabs hiding every single feature – in favour of the older model of multiple toolbars that you can show or hide as you please. Yes, this means you could potentially have 25 toolbars open and virtually none of them visible, but at least you can customise which tools are visible without having to flip between tabs on a ribbon.

That's ideal for people who have a specialised role in document creation and really want a subset of tools that are always available. If you're an editor, for example, having the review tools onscreen is important.

One core feature that isn't included in LibreOffice is live document collaboration of the kind built into both Google Docs and the online version of Microsoft Office (and is being brought gradually into Office 16 for Windows). You can't have several people working on a document at the same time, meaning you have to shuffle files around using email or shared drives (such as Dropbox) instead. How important this is to you will depend on the kind of work you do, but it certainly feels like an omission for an office suite in the second decade of the 21st century.

■ Writer

There are two major trends in tools for writing: simplified applications that provide minimal distraction and let you focus on the words; and complex beasts that have tools for pretty much any kind of document creation. Writer definitely falls into the latter category.

ABOVE LibreOffice's Calc happily opened every Excel document we threw at it

If you've used Microsoft Word over the past 20 years, there's nothing radically different here. It's comprehensive, with tools for optimising layout, creating indexes, footnotes and much more. If you have any specialised needs for document creation, whether as a business or academic user, Writer has you covered. Thanks to features such as styles, the navigation palette and anchors, it's particularly well suited to creating long documents – something that free competitors such as Google Docs seem to struggle with.

Interoperability with Microsoft Word is an important feature for most users nowadays, and Writer also delivers in this respect. Version 5 includes additional compatibility features, in particular the ability to preserve and correctly represent text highlighting in Word documents. You can even specify whether you would rather export your character backgrounds as highlighting or shading when saving as Word files.

Some of Writer's longest-standing bugs have finally been fixed. Page numbers no longer become random in draft mode, and you can now, at last, create paragraphs that contain more than 65,000 characters. This last one probably won't bother many, but for those it did affect (largely in the legal profession) it was a show-stopper.

One of our biggest bugbears with Writer previously was the way it handled inserting images into documents. Many don't provide tools to crop an image, or if they do, you have to enter numeric values to crop

✚ It's free, compatible and has most of the capabilities of Microsoft Office
✚ It looks old-fashioned and lacks live collaboration

– hardly the most user-friendly process. In version 5, Writer gets this right by allowing you to crop using the mouse. This sounds like a small feature, but it's a real time-saver.

Overall, Writer is a powerful word processor that costs nothing and can do almost everything Microsoft Word can. Yes, it's not as pretty – although as we note above, the old-fashioned look has its advantages – but if you want a word processor that can handle long, complex documents and you don't want to tie yourself to Microsoft, it's a very good choice.

■ Calc and Impress

It's a mark of Calc's maturity that it happily opened every Excel document we threw at it, including some with complex pivot tables, conditional formatting and graphs – all without losing any formatting or data. That's impressive. Not so long ago, it (and every other non-Microsoft option) would have choked on the same documents.

If you're familiar with Excel, you'll be up to speed with Calc very quickly. All the power you'd expect is there, and of course, the complexity too.

One disappointing area, and one that's hard to see LibreOffice improving on in the near future, is macros. Calc's macros are basically incompatible with VBA, so if you have any existing macros you'll need to rework them. The good news is that the macro language built into Calc is very capable, so there's little you can't do with it. However, if you're a person who has spent years creating Excel macros, you'll have to relearn plenty to make the switch.

Impress, the presentation software bundled with LibreOffice, is the least complete of the main packages (perhaps open-source coders don't do many presentations). When



importing some complex presentations with background graphics, it missed things out, so those who have a lot of existing PowerPoint files will probably want to keep a copy of Office to hand.

However, it's perfectly adequate for creating new presentations. All the tools you need are here, including templates. That said, one minor irritation is that you can't add comments to slide notes, which means that if you're a team preparing a presentation that relies a lot on the notes, taking in comments or suggested amendments from your colleagues is tricky.

■ Verdict

From a reviewer's point of view, open-source software is always the hardest to rate. It always feels vaguely churlish to give a bad review to a piece

ABOVE Impress feels like the least complete of the main packages

of software that unpaid volunteers have spent their free time slaving over. However, on the other hand, and especially with a piece of mission-critical software such as an office suite, you need to compare it with paid-for (and sometimes expensive) products.

With this in mind, LibreOffice gets a middling rating overall. Despite its updates it still looks and feels old-fashioned – although that has its positives as well as negatives, particularly if you're familiar with older versions of Microsoft Office. The lack of a cloud services supporting it also means

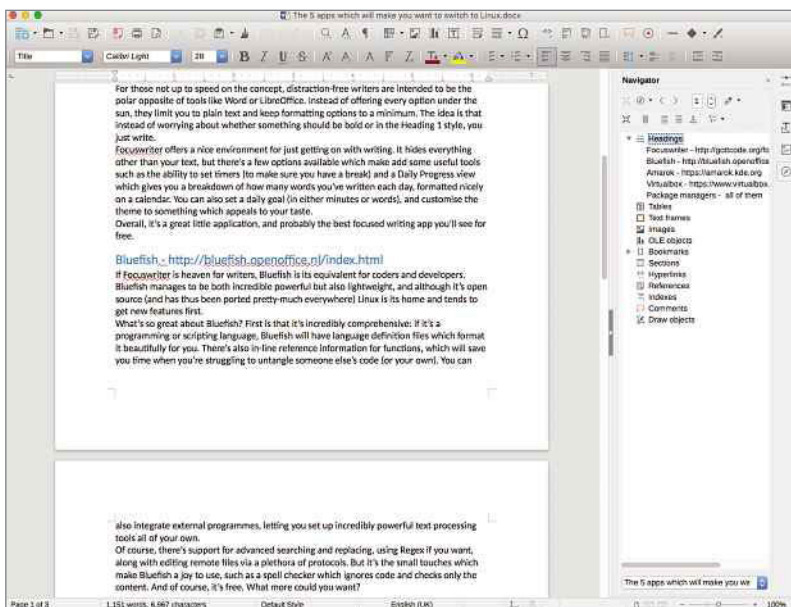
“The lack of cloud support means there are no collaboration features of the kind you'll find in Google Drive or Microsoft Office”

there are no collaboration features of the kind you'll find in Google Drive and that are being built into Office. Whether that matters to you depends on what kind of user you are.

Leaving aside the more underpowered elements of LibreOffice – such as Impress – what you have is a powerful office suite that can meet the needs of demanding users, but only if they work alone or don't mind passing documents backwards and forwards using drive services such as Dropbox. Modern business users, for whom live collaboration is increasingly important, will have to weigh up the positives and negatives carefully before abandoning Office.

However, if you need powerful features in a spreadsheet or word processor, don't work collaboratively and are on a very tight budget, LibreOffice will meet your needs very well. It's certainly worth a try for free. **IAN BETTERIDGE**

LEFT LibreOffice Writer looks quite old-fashioned, but this has its advantages



The 7 products every professional should keep in their briefcase



1 Mobile scanner Xerox DocuMate 3115

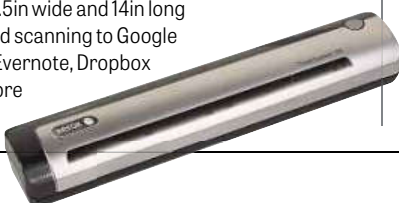
Some clever thinking here: when you're on the road and need to scan contracts, receipts, documents, photos and the rest, the Xerox DocuMate 3115 slips in your briefcase (all powered by USB, naturally). And when you're back in the office, slot it into the docking station, below right, complete with a 20-page-per-minute automatic document feeder.

£310 xeroxscanners.com

While the DocuMate 3115 is Xerox's flagship mobile scanner, it's by no means your only choice. Here are two alternatives that may be right for you:

Xerox Travel Scanner 150 £128

- Instant scan to searchable PDFs for easy search and retrieval
- USB-powered – no external power supply needed
- Lightweight (300g) but scans items up to 8.5in wide and 14in long
- Cloud scanning to Google Drive, Evernote, Dropbox and more



Xerox Mobile Scanner £221

- 4GB SD Eye-Fi Card plus built-in Wi-Fi included
- No computer or cables required to scan
- 300 pages per battery charge
- Compatible with many different types of mobile device



xeroxscanners.com

2



Pico projector Asus S1

Let's not pretend you'll get the brightest image from a pico projector, but when you need to share your screen this works a whole lot better than clustering around a laptop. Despite weighing just 340g, it still packs 200 lumens and an HDMI output, and can project a 41in diagonal from 1m away. Plus it lasts three hours from a single charge.

£267 amazon.co.uk

3



Mobile hotspot Goodspeed 4G

We've all been there: you need to connect to the internet but the Wi-Fi won't work. It's especially bad when you're abroad and can't use your phone. There are plenty of options, but we like the Goodspeed 4G because you can buy SIMs for multiple countries and it's so easy to use: connect and go, just like you would with a Wi-Fi hotspot in the home or office.

£17 per month goodspeed.io

4



Secure external hard drive 750GB iStorage IS-DG3

Quick, lightweight external hard drives are perfect if you need to make a backup while on the road (or just want to use it as a mobile jukebox). For extra security, though, consider an encryptable, password-protected model such as the iStorage IS-DG3, complete with a brute-force self-destruct feature.

£201 stuff-uk.net

5



Emergency power pack Techlink Recharge 12000

Forget USB chargers that slip in your pocket: real power junkies need a power pack with huge amounts of juice, and right now that means the Techlink Recharge 12000 (with 12,000mAh of juice). With both USB and Lightning connectors, it has enough capacity to fully charge an iPad Air or four smartphones.

£90 amazon.co.uk

6



Foldable USB plug with double the power Mu Duo

This is one of those blissful devices you can slip into your case, bag or even pocket, then forget about until you need it. Not only does it improve upon conventional USB plug chargers by offering two USB sockets rather than one, it also folds down to around 1cm thick. If you want to charge tablets fast, the Mu Tablet costs £24.

£22 themu.co.uk

7



Tablet keyboard Microsoft Universal Mobile Keyboard

If you want to get some serious work done on your tablet, you need a proper keyboard. Personal preference matters here – *PC Pro* columnist Davey Winder swears by the £19.50 MiniSuit Keyboard Case for his Nexus 7 – but in terms of maximum compatibility, Microsoft's keyboard is our top choice.

£54 amazon.co.uk

Intel Skylake

Speed enthusiasts should look no further: a great upgrade with new features to match

PRICE Core i5-6600K, £167 (£200 inc VAT); Core i7-6700K: £333 (£400 inc VAT) from amazon.co.uk

Just as we were getting to know Intel's Broadwell CPUs, their successors have arrived: the sixth-generation Skylake range. The rapid turnaround is down to delays in the release of Broadwell, which saw the 14nm chips hit mass production a year later than planned. Now that the 14nm process is up and running, a quick switch to the new Skylake architecture puts the company back on schedule – for now anyway (see *Introducing Kaby Lake*, below).

Skylake's new features include an improved branch predictor and larger buffers for out-of-order execution; in practical terms, that means the CPU spends less time waiting for data and instructions, improving overall performance. Skylake also introduces a new system called Speed Shift, which lets the CPU manage its own power state, rather than following the operating system's lead, enabling it to match demand more precisely. The overall effect

is a respectable performance boost: the first Skylake desktop chip, the Core i5-6600K, proved 17% faster in our desktop-based image-editing benchmark than the Haswell-based Core i5-4670K.

Of course, the CPU core is only half the story. The new HD Graphics 500-series GPU brings support for DirectX 12, OpenCL 2 and OpenGL 4.4, with claimed performance benefits of 20-40% over last-generation silicon. That's borne out by our experience: in High quality mode at 720p, we saw average frame rates in *Dirt: Showdown* leap from 32fps on the Core i5-4670K to 45fps on the new Skylake chip.

Also of interest are new hardware functions: a dedicated H.264 encoder can drive wireless displays without taxing the general-purpose graphics hardware, and there's support for the more efficient H.265 codec too. Photographers will be pleased to learn that Skylake also introduces new hardware features aimed specifically at processing raw camera images.

The third leg of the stool is the chipset, which introduces support for superfast DDR4 memory – although compatibility with DDR3 remains too. A new webcam controller promises “zero-shutter lag” on sensors up to 13 megapixels, plus features such as burst mode and face detection.

Other onboard controllers include SATA Express and Thunderbolt 3 – capable of running at 40Gbits/sec over a USB Type-C port. While it doesn't appear to be mandatory, Intel is also pushing WiGig alongside Skylake, to allow all sorts of peripherals to be connected wirelessly. Prior to the launch, it was rumoured that wireless charging would be included too, but Intel has remained quiet on that idea this time around.

The first two Skylake CPUs – the 4GHz Core i7-6700K and 3.5GHz Core i5-6600K – are on sale now. Both are desktop chips aimed at the high-performance end of the market, but they'll soon be joined by a full range of Core i3, i5 and i7 parts, in both desktop and mobile forms. Specifics are yet to emerge, but similar to Haswell the family will be divided into Y, U, H and S classes, with TDPs ranging from 4W to 91W.



ABOVE A highly desirable chip, but note the Skylake desktop CPUs need a new LGA 1151 socket

They'll also be joined by new low-power Core M parts – now ranged into Core m3, m5 and m7 models, to support both dirt-cheap devices such as Intel's Compute Stick and ultraportables such as the Apple MacBook.

Later this year, we can also expect vPro variants, plus Skylake Celeron and Pentium chips for the budget market – while those seeking higher performance may be tempted by new quad-core and unlocked mobile parts. The first mobile Xeon is on its way too, along with new Iris and Iris Pro GPUs.

We encountered our first Skylake processor last month, inside the Chillblast Fusion Centurion. The unlocked Core i5-6600K, overclocked to a maximum of 4.34GHz, helped that

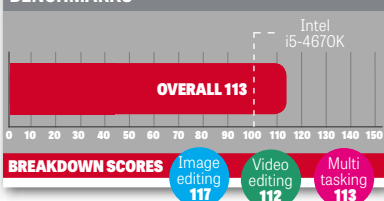
system achieve a stupendous overall benchmark score of 137. At its stock frequency, our test system scored 113 overall, versus the 100 achieved by our Haswell-based reference system.

What that says about the platform as a whole remains to be seen. Some Skylake chips will have large caches, Hyper-Threading and generous Turbo Boost capabilities, while others will focus on minimising size, heat and power consumption. All things being equal, however, any Skylake chip should comfortably outpace a comparable Broadwell CPU, and will benefit from new GPU and chipset features too. It's an upgrade that's well worth the surprisingly short wait. **DARIEN GRAHAM-SMITH**

“The chipset introduces support for superfast DDR4 memory – although compatibility with DDR3 remains too”

+ Faster and more efficient than Broadwell – what's not to like?
— The fast turnaround might frustrate anyone who's just bought a new computer

BENCHMARKS



Introducing Kaby Lake

According to Intel's original “Tick-Tock” timetable, Skylake was supposed to be followed next year by a shrink to 10nm, dubbed Cannonlake. But after the delays that beset Broadwell's move to 14nm, Intel has wisely tweaked its roadmap to defer Cannonlake until 2017. Instead it now plans to introduce an interim 14nm architecture, codenamed Kaby Lake, next year. That may be preferable to two years of stagnation, but it's a very short development period for a new CPU. We'll be watching with interest to see what improvements Intel manages to work into the new design.

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Mobile apps

Todoist 10

SCORE ★★★★★

PRICE Free; Premium features, £18/yr



There are a million and one task-management apps with varying degrees of complexity, but few offer the same power and range of platforms as Todoist. At its simplest level, Todoist allows you to break down projects into lists of tasks. Projects can have subprojects, letting you group different categories (such as home or work projects) together, and tasks can have labels – allowing you to group together all of your phone calls or emails in one place.

The design of Todoist on both Android and iOS is simple and elegant. It's easy to get to grips with quickly, and includes the ability to share projects with other users. You can then delegate tasks within the shared projects to other people, making it ideal for teams or families.

Todoist has two levels of service: free and premium. Premium costs £18 per year, but adds a slew of features that anyone who is serious about

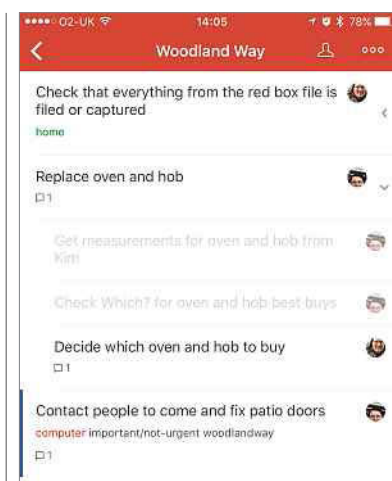
managing tasks is likely to want. They include reminders of upcoming tasks, either by mobile, email or SMS, as well as location-based notifications on Android and iOS. Tasks can have notes and even documents attached to them, which is particularly useful if you're dealing with a shared task list.

Premium also adds custom filters, which are a dream for power users. You can filter tasks by a wide range of criteria, including who is assigned to a shared task, when it's due or its associated project. Importantly, you can chain all of these together to create – for example – a filter that shows all of your assigned tasks due in your work projects over the coming week.

The drawback with filters is that they're not exactly plain English. For example, let's say I create tags called "@life" and "@work" to keep my personal and work projects separate. If I want to see all work tasks assigned to me, the filter I need is "!:to_others: & !@life". It's certainly a powerful feature, but compared to something like OmniFocus' Perspectives, which perform a similar function, it's pretty hard to use.

Then again, OmniFocus is only available on iOS and Mac, while Todoist works on pretty much any

RIGHT The design of Todoist on both Android and iOS is simple and elegant



"You can filter tasks by a wide range of criteria, including who is assigned to a shared task, when it's due or its associated project"

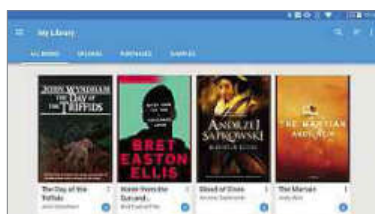
platform – either via a dedicated app or web browser. Todoist also lets you share to-do lists, and there's even a business account option for teams.

Overall, Todoist is a close-to-perfect product for managing tasks across a wide range of platforms, especially if you want to share them. Whether you're a family looking to divide household chores or a business wanting to delegate in your team, Todoist is a great choice. **IAN BETTERIDGE**

Google Play Books

SCORE ★★★★★

PRICE Free



Like to use your Android device to read? While there are plenty of ebook apps out there, Google's own Play Books is fantastic.

Usually coming preinstalled on vanilla Android devices, Google's ebook reader packs in features other free apps lack. The capability may not be initially apparent, but you can upload your own ebooks and PDF files to Play Books and access them on any Android device associated with your login, with your progress being synced across devices. This means you can read on your tablet when at home, then later pick up your phone and carry on reading when out and about. That's not a bad function for a free app. **VAUGHN HIGHFIELD**

ABOVE Google Play Books packs in features other free ebook apps lack

You Must Build a Boat

SCORE ★★★★★

PRICE £1.99



At first, You Must Build a Boat looks like a regular puzzle game, in which you slide blocks around to match symbols. But you quickly realise there's much more to this addictive, fast-paced, side-scrolling RPG.

Your task is simple: you must build a boat. To obtain the necessary parts, and assemble a crew, you'll find yourself raiding caves, tombs, bunkers and Japanese pagodas. You'll also meet monsters, and fight them by mastering the sliding-block puzzle mode, matching sword or staff tiles to attack and defend. You can also build strength and intelligence to improve your character and recruit new shipmates. You Must Build a Boat is fantastic fun. **VAUGHN HIGHFIELD**

ABOVE You Must Build a Boat seems simple at first, but has deceptive depth

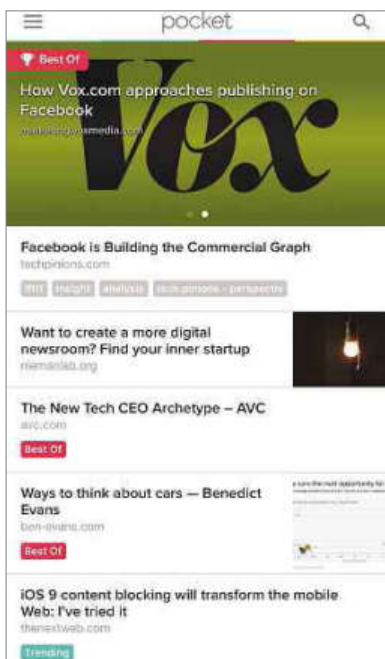
Pocket 6

SCORE ★★★★★

PRICE Free; Premium version, £35/yr



Pocket has long been one of the leading applications for saving web pages for reading later. You can clip articles to it using a browser extension or bookmarklet, or use one of the many integrations with other applications (such as feed readers) to get content in. Pages are saved to your mobile device and stripped of formatting and ads, making them much easier to read. This happens in



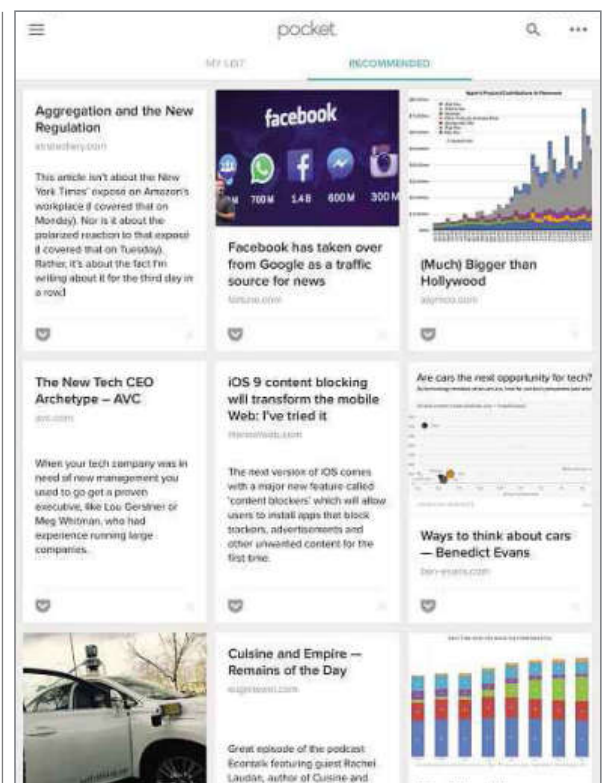
the background, so you don't need to worry about having to open the application and download articles.

Once the pages are saved, you can share links to them, mark them as favourites, add tags for easier navigation and even play back the article using text-to-speech. However, you'll often just be reading them, and as a method of putting together a reading list for those ideal moments when you have time, Pocket is a great application

The biggest improvement in version 6 is the addition of suggestions through a new "Recommended" tab. Recommendations are based on the most popular articles saved to Pocket, tailored to topics and sites you've saved in the past. You can add the recommendations to your main reading list with a single tap.

For me, this worked well enough to recommend articles I would be interested in but, unfortunately, it also meant that I'd already read many of them outside Pocket. The suggestions also lacked a bit of the surprise factor that should be built into every recommendation engine. Most of what I normally save to Pocket is about technology, so Pocket recommended lots of technology articles to me. It could have done with a sprinkle of other stuff to surprise me a bit.

Instapaper, Pocket's main competitor, also has a recommendations system, but, instead of being based solely on an algorithm, it also uses links shared by the people you follow on Twitter. This gives it more of a curated flavour and we found its recommendations to be better overall than Pocket's. Having said that, we'd expect Pocket



ABOVE Suggestions are based on popular articles and can be tailored to you

LEFT Articles are stripped of formatting and ads, making them easier to read

to tweak its recommendation engine and improve things over time.

Pocket has two tiers of pricing, free and Premium. Premium, which costs £35 per year, gives you a permanent library of all the content you save, full-text search of all your articles, and suggested tags for each article. Is it worth it? For the hardcore user who piles stuff into Pocket constantly and uses it as an archive of content, probably. However, if all you want to do is to read web pages saved offline, then the free version will be more than enough. **IAN BETTERIDGE**

Steve Reich's Clapping Music

SCORE ★★★★★

PRICE FREE



An avant-garde American composer may not be the most obvious starting point for an addictive rhythm game, but developer Touchpress has managed to create a fun app based on a 1972 Reich composition performed entirely by clapping.

The aim here is to tap the screen in rhythm, which starts hard and ramps up further in difficulty when the claps abruptly change pattern. You'll most likely give up in sheer frustration every couple of minutes – think Flappy Bird (or Clappy Bird) – but the minimalist design and information about Reich's music will keep you coming back for more. **THOMAS MCMULLAN**



ABOVE The game is frustrating at first, but the design will keep you coming back

Glitché

SCORE ★★★★★

PRICE 79p



What used to happen for free with VHS players is now the subject of an app that lets you turn photos into glitchy works of art. For less than a quid you get a sizeable range of tools, from databending to turning pictures into a grid of emoji. There's definitely a book waiting to be written about the popularity of the glitch as an aesthetic – the purposeful created from the accidental – but it's probably best not to think too hard and just enjoy making freaky photos.

There are more than enough tools included in the base version to impress and terrify your followers, but you'll need pay £2.29 for the Pro version's hi-res exports. **THOMAS MCMULLAN**



ABOVE You can terrify your followers by creating glitchy or emoji-filled works of retro art



Contents

Apple Watch Sport	82
LG Watch Urbane	83
Acer Liquid Leap	84
Asus ZenWatch	84
Fitbit Surge	85
Garmin Vivoactive	85
Microsoft Band	88
Motorola Moto 360	88
Pebble Time	89
Sony SmartWatch 3	89
Buyer's guide	79
Feature table	80
Design your own watch face	86
View from the Labs	90
Test results	90



GET SMART

Which of the many smartwatches or fitness bands should adorn your wrist? We test ten of the latest models to help you decide



You probably don't need a smartwatch. Even the cheapest smartphone will keep you on top of your inbox and your diary, give you voice search and navigation, and buzz with a stream of notifications. It will even give you the time. There's a strong argument that a smartwatch is a £150-£350 device that's sole purpose is to save you the bother of pulling your smartphone from your pocket.

All the same, you probably want a smartwatch anyway. What's more, there's a good chance that you'll find one really useful and wonder how you ever lived without it.

Set it up correctly, and there's no doubt that a smartwatch can help you stay more organised and work more effectively. Whether you're focusing on a task or just enjoying a day out, you can quickly check a smartwatch without becoming distracted. It gives you what you need at a glance.

A smartwatch is also less obtrusive than a smartphone, which is great news when you're trying to navigate through London or check the football score halfway through a family dinner. The biometric hardware and friendly software can





make fitness and lifestyle tracking more accessible. Even the most hopeless salad dodger might get enough encouragement to turn things around. What's more, we're still in the early days. Who knows what future apps and OS updates will bring?

Types of smartwatch

The smartwatch market has two ancestors. On one side, we have the dedicated smartwatches, with origins in the world of smartphones and apps. In the other, we have fitness watches, with their roots in exercise-tracking technology. Over the past 18 months, we've seen smartwatches taking on

more fitness functionality, while the fitness watches have adopted smartwatch features, but there's still a distinction between the two. Then again, we also now have hybrid devices such as the Microsoft Band and Acer Liquid Leap.

Devices at the fitness end of the spectrum are designed to be robust and practical rather than attractive, while those at the smartwatch end put looks and screen size first. Technology doesn't get any more personal than a smartwatch, so you really need to make sure that the device will fit your lifestyle, tastes and, in some cases, physique. A Motorola Moto

360 that looks good on those with beefy forearms might look huge on a skinny wrist, while the retro charms of the Pebble Time may not sit well with your smart suits and polished brogues.

There are also big disparities in screen technology. Fitness watches gravitate towards transfective LCD screens that are visible in bright sunlight and don't consume much power, boosting battery life at the expense of presentation. AMOLED and OLED screens offer rich colours and a sharper, brighter image, but at the expense of battery life. In fact, to guarantee all-day running you may



		LABS WINNER		
	Acer Liquid Leap	Apple Watch Sport	Asus ZenWatch	Fitbit Surge
Overall score	★★★★☆	★★★★★	★★★★☆	★★★★☆
Pricing / support				
Price (inc VAT)	£58 (£65)	£249 (£299)	£146 (£175)	£145 (£174)
Manufacturer	acer.co.uk	apple.com/uk	asus.com/uk	fitbit.com/uk
Supplier	laptopsdirect.co.uk	apple.com/uk	pcworld.co.uk	amazon.co.uk
Dimensions (WDH)	12 x 9.5 x 39mm	33 x 10.5 x 39mm	40 x 9.4 x 51mm	24 x 12 x 21mm
Weight	20g	25g (without strap)	75g	32g
Warranty	1yr RTB	1yr RTB	1yr RTB	1yr RTB
Display				
Size	0.9in (strip)	1.5in (square)	1.63in (square)	1.25in (rectangular)
Resolution / panel type	128 x 32 OLED	340 x 272 AMOLED	320 x 320 AMOLED	TFT (resolution not specified)
Glass type	6H hardened glass	Ion-X	Gorilla Glass 3	Gorilla Glass 3
Key features				
OS	Proprietary	watchOS 1.0.1	Android Wear 5.1	Proprietary
RAM / storage	16KB / 256KB	512MB / 8GB	512MB / 4GB	Not specified
Wi-Fi / Bluetooth	✗ / 4	802.11n / 4	✗ / 4	✗ / 4
Battery capacity	Not specified	205mAh	369mAh	Not specified
Charging port	Proprietary cradle	Proprietary magnetic USB	Proprietary cradle	Proprietary
Water resistance (IP rating)	IPX7	IPX7	IP55	IP54
Compatibility	iOS 7+; Android 4.3+	iOS 8.2+	Android 4.3+	iOS 7+; Android 4.3+
Sensors				
Heart-rate sensor	✗	PPG and infrared	Biosensor	Optical
GPS / compass	✗ / ✗	✗ / ✗	✗ / ✗	✓ / ✓
Accelerometer	✓	✓	✓	✓
Ambient-light sensor	✗	✓	✗	✓
Functions & notifications				
Message / event notifications	✓ / ✓	✓ / ✓	✓ / ✓	✓ / ✗
Call screening / voice calls	✓ / ✗	✓ / ✓	✓ / ✓	✓ / ✗
Voice controls / message dictation	✗ / ✗	✓ / ✓	✓ / ✓	✗ / ✗
Turn-by-turn navigation	✗	✓	✓	✗
Alternative watch faces	✗	✓	✓	✓
Music controls	✓	✓	✓	✓
Other	✗	Camera remote; weather	Camera remote; Google Now; health and fitness apps	Health and fitness apps; run tracking
Straps & accessories				
Strap attachment method	Integral	Proprietary handlebar	22mm	Integral
Other accessories	Charging cradle	Magnetic cable; additional strap	Charging cradle	USB cable

find your smartwatch displays no screen when it's not in active use. The Pebble Time finds a balance between the two by offering colour on a low-power, e-paper screen. What's more, it still works brilliantly in sunlight.

Screen shapes and sizes vary enormously, with the Acer Liquid Leap and Microsoft Band opting for narrow strips, while the Moto 360 and LG Watch Urbane go for a traditional round face. Strips are fine for fitness bands, but offer less space for smartwatch features such as navigation or notifications, and while square screens are more

"Technology doesn't get any more personal than a smartwatch, so make sure the device will fit your lifestyle"

practical for reading text, looking at your schedule and checking maps, many people simply won't consider a watch that isn't round.

Performance

Smartwatches are companion devices, designed to work in close contact with a smartphone. As a result, CPU horsepower isn't critical. However, we're beginning to see older models struggle with the latest version of Android Wear, and as the apps and operating systems grow more sophisticated, some models are more future-proof than others.

It's a similar story with storage and RAM. The Pebble has a fraction of the capacity and memory of the Apple Watch or LG Watch Urbane, but the lightweight OS and apps don't need more. Your smartphone will handle the grunt work.

Here, the more important factor is the feature set, and more specifically the sensors. All smartwatches employ some kind of accelerometer to track movement and count your daily steps – although some use fewer or less sophisticated sensors that don't produce accurate data. Some include

Continued on p90



	LABS WINNER				
Garmin Vivoactive	LG Watch Urbane	Microsoft Band	Motorola Moto 360	Pebble Time	Sony SmartWatch 3
★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
£136 (£163)	£187 (£224)	£133 (£160)	Light gold, £208 (£250)	£150 (£180)	£94 (£113)
garmin.com/uk	lg.com/uk	microsoft.com	motorola.co.uk	getpebble.com	sonymobile.com
amazon.co.uk	amazon.co.uk	pcworld.co.uk	o2.co.uk	firebox.com	amazon.co.uk
44 x 8 x 39mm	46 x 11 x 52mm	19 x 8.7 x 50mm	47 x 11.9 x 46mm	38 x 9.5 x 41mm	36 x 10 x 51mm
38g	67g	60g	49g	43g	74g
1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB
1.13in (square)	1.3in (circular)	1.4in (strip)	1.56in (circular)	1.25in (square)	1.6in (square)
205 x 148 transfective TFT	320 x 320 P-OLED	320 x 106 TFT	320 x 290 IPS	144 x 168 LTPS	320 x 320 transfective TFT
Hardened	Gorilla Glass 3	Hardened	Gorilla Glass 3	Gorilla Glass 3	Hardened
Proprietary	Android Wear 5.1	Proprietary	Android Wear 5.1	PebbleOS 3	Android Wear 5.1
Not specified	512MB / 4GB	128KB / 64MB	512MB / 4GB	256KB / 1MB	512MB / 4GB
✗ / 4	✗ / 4.1	✗ / 4	✗ / 4	✗ / 4	802.11n / 4
Not specified	410mAh	2 x 100mAh	320mAh	150mAh	420mAh
Proprietary cradle	Proprietary cradle	Proprietary magnetic cable	Qi wireless charging	Proprietary magnetic cable	micro-USB
5ATM	IP67	IP54	IP67	N/A (30m)	IP68
iOS 8+; Android 4.3+	Android 4.3+	iOS 7.1+; Android 4.3+; Windows Phone 8.1	Android 4.3+	iOS 8+; Android 4+	Android 4.3+
✗	PPG	PPG	PPG	✗	✗
✓ / ✓	✗ / ✗	✓ / ✓	✗ / ✗	✗ / ✗	✓ / ✓
✓	✓	✓	✓	✓	✓
✗	✗	✓	✓	✗	✓
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✗ / ✗	✓ / ✓	✓ / ✗	✓ / ✓	✓ / ✗	✓ / ✓
✗ / ✗	✓ / ✓	✓ / ✓	✓ / ✓	✗ / ✓	✓ / ✓
✗	✓	✗	✓	✗	✓
✓	✓	✗	✓	✓	✓
✓	✓	✓	✓	✓	✓
Health and fitness apps; run tracking	Google Now; health and fitness apps	Cortana; health and fitness apps	Google Now; health and fitness apps	✗	Google Now; health and fitness apps
24mm	22mm	Integral	22mm	22mm	Proprietary
Charging cradle	Charging cradle	Magnetic cable	Charging cradle	Magnetic cable	micro-USB cable

Apple Watch Sport

Others trump it on battery life and value, but Apple offers the best smartwatch experience

SCORE ★★★★★

PRICE £249 (£299 inc VAT)
from apple.com/uk

The Sport may be the cheapest of the many Apple Watch models, but even still it's a tough proposition on value. With the 38mm version clocking in at £299, and the 42mm version adding £40 to the price tag, it's around a third more expensive than most of its competitors in this test – and that's without moving up into the £579-£12,000 price range of the more luxurious models.

It's not a winner in other departments, either. Battery life, at around a day and a half, is a long way short of the LG Watch Urbane or even the Sony SmartWatch 3. While the Watch Sport has sophisticated heart-rate sensors, accelerometers and gyroscopes, it doesn't have onboard GPS. What's more, step count and heart-rate monitoring while running or walking is slightly off the pace logged by the Fitbit Surge and Microsoft Band, albeit only by a few beats per minute in the early stages of a run, or 65 steps over 3km.

Why, then, does the Apple Watch claim the winner's crown? For a start, hardware design. The Apple Watch Sport is by far the lightest and most comfortable watch on test. Thanks to its smoothly contoured back and Apple's aluminium alloy, the 38mm version weighs only 25g and the 42mm 30g (without the strap). The fluoroelastomer – or artificial rubber – strap is so soft against the skin that you practically forget it's there. The touchscreen is also sensational; pin-sharp with vibrant colours and ample brightness in sunshine.

Then there's the haptic feedback. Where other watches buzz away on



“The biggest thing in Apple's favour is that the Watch Sport feels like a platform in its own right”

RIGHT We wouldn't recommend the more expensive versions of the Apple Watch

BELOW An array of sensors can be found on the back of the Watch



your wrist for notifications, the Apple Watch hits you with a spookily focused tap, instantly grabbing your attention. Where Android Wear watches sometimes need a jiggle to wake up, the

Watch Sport is unerringly responsive. Even charging is handled well, with the small magnetic disc of Apple's USB cable clamping instantly to the back of the watch.

In most respects the software is as good as you'd expect. Upward and downward flicks take you to your notifications or a series of “Glances” – one-shot views of apps that hit you with the most important information. Tapping on one opens the relevant app. A low-profile button on the right calls up a ring of icons for favourite contacts, enabling quick messaging and calling, while pressing the Digital Crown takes you to your app launcher – a cluster of tiny icons that's surprisingly precise in use. The crown itself handles vertical scrolling in apps, giving you an uninterrupted view of the screen. It's better than Android Wear in almost every respect.

Apple's built-in app selection covers all the basics, including fitness and navigation, and while specialist

fitness watches offer more detailed performance tracking, the Watch Sport's friendly apps do a fantastic job of encouraging a more active lifestyle – and the more high-end apps are there if required.

The biggest thing in Apple's favour is that the Watch Sport feels like a platform in its own right, not just a companion device. While there are still plenty of times when an app will hand you over to your iPhone, there's plenty you can do on the watch itself, and the range of apps is already impressive. Prefer Google's Inbox to Apple's Mail client? Sunrise to the native Calendar? The Watch has you covered. There's everything from Slack and WhatsApp messaging to simple role-playing games, and Siri's speech recognition does a reasonable job with searches, reminders and short texts, even handling punctuation.

Battery life might not be up to much, but the overall experience is better than any other smartwatch we've tested. And while Apple's software has imperfections – lack of customisability is a bugbear, and you can't get Siri to transcribe emails – the forthcoming watchOS 2 looks set to iron out many of the niggles. We wouldn't recommend stumping up for the premium versions, but if you want the best smartwatch of the moment, this is it.



LG Watch Urbane

Great features, performance and battery life – the LG Watch Urbane is the best Android smartwatch

SCORE ★★★★★

PRICE £187 (£224 inc VAT)
from amazon.co.uk

Round faces are all the rage among Android Wear manufacturers, and with the Watch Urbane it's easy to see why. It might be a little thicker and heavier than your average mid-range timepiece, but it looks like the kind of watch that people – albeit mostly men – actually buy. Not all of us like the styling or admire the finishing, but with its leather strap and the right watch face, the Watch Urbane looks sophisticated. There's no danger of forgetting that it's there, though, at 67g.

The 1.3in P-OLED screen has a 320 x 320 resolution, and it's bitingly sharp. Blacks look black, colours look rich and punchy. Reading notifications, swiping through Google Now cards and navigating maps is a pleasure. Our only serious grumble is that it's hard to see when you're out in the sun.

There are even more goodies when you turn the smartwatch over. As well as the contacts for the bundled clamp-on charging cradle, the Watch Urbane has a proper photoplethysmographic (PPG) heart-rate monitor. Use Android Wear's own heart-rate-monitoring functions and the results are all over the shop, but use the LG Pulse app and it's a different story, matching the Fitbit Surge and Apple Watch for credible results.

The Watch Urbane doesn't nod off when it's counting steps, either, although the leather strap and design don't make for the



“Reading notifications, swiping through Google Now cards and navigating maps is a pleasure”

most practical fitness watch. It might be IP67-rated, but that means it's ready for a quick dip in the washing-up bowl, not a few laps of the local pool. Like the Apple Watch, the

Watch Urbane is better suited to nudging your average, moderately active person along the right path than for any serious training.

Beyond LG Pulse, a rather pointless touch-based phone dialler and some specially designed watch faces, the Urbane is a fairly straightforward Android Wear watch. Even so, it's still the best. The wearable OS is maturing nicely, and LG's hardware does a great job of showcasing it. After a day or so of use, the flicks and taps to view and dismiss notifications, launch apps and flick through Google Now cards become second nature.

Top up the built-in app selection with your favourite fitness apps or must-haves such as Wunderlist and ViewRanger, and the Watch Urbane becomes a great smartphone companion. You can respond to texts

and emails using voice, ready-made replies or hand-drawn emoji, and LG's microphone doesn't have any problems with voice recognition. New actions enable you to scroll

through notifications with a flick of your wrist, and these work reliably when you haven't got a free hand.

It's also likely to last. With a Snapdragon 400 processor and 512MB of RAM, performance is impeccable, and the Watch Urbane should be equipped to cope with future Android Wear updates. Even battery life is excellent: we wouldn't quibble with the predicted battery life of more than 60 hours, which is about as good as it gets with an Android Wear device.

This isn't the ultimate smartwatch, and Apple's design nous and attention to detail is leagues ahead of LG's. Those who don't like the styling might prefer the Watch Urbane's stablemate, the cheaper G Watch R. If you like its looks, though, don't hesitate. The Watch Urbane is one storming smartwatch.

RIGHT The leather straps and design don't make for the most practical fitness watch

BELOW The LG has a proper PPG heart-rate monitor



Acer Liquid Leap

A cheap fitness band/smartwatch hybrid, but the Liquid Leap won't leave you cheerful

SCORE ★★☆☆☆

PRICE £58 (£65 inc VAT)
from laptopsdirect.co.uk

Acer's leap into the smartwatch world is a hybrid band, packing a handful of smartwatch features into a low-cost fitness device. It looks low-rent, and our white review sample was hard to keep clean, if reasonably robust. Acer claims it's waterproof, although only for up to 30 minutes in depths of up to one metre. Paddling pool swimmers only, then.

It's not hard to find evidence of the low budget. The strap is comfortable but hard to fit, with studs that only just squeeze through the holes provided. It charges via a tiny plastic cradle that feels like it fell out of a Christmas cracker, with an awkward

clamp that clicks in place over the watch. The simple monochrome OLED screen has a poor 128 x 32 resolution, and is only just bright enough to see in sunlight. The Liquid Leap eschews any sophisticated sensors, packing only an accelerometer for step and motion tracking, and the capacitive touchscreen.

The best thing about the Liquid Leap, beyond the price, is that it's very simple to use. It pairs easily using Bluetooth, while the Leap Manager apps for iOS and Android make it easy to set and track fitness goals. Notifications for emails, messages, calls and events come through smoothly, and you simply sweep through the fitness function to find the music-player control app.

However, none of these functions performed brilliantly. The step counts didn't tally with those of specialist fitness bands when used on a walk, while space for notifications is so limited you barely see more than a subject line. Its sleep-tracking features aren't exactly impressive: you turn the app on when you go to bed and turn it off when you get up, and that's as sophisticated as it gets.



ABOVE You won't find a more affordable smartwatch

You'll struggle to find a more affordable smartband and, at a projected 60 hours, battery life is excellent. The Leap also offers basic notifications and fitness tracking, which is more than can be said for the Fitbit Surge. All the same, you'd be better off buying a budget fitness band without smartwatch pretensions or saving up for a proper smartwatch.

Asus ZenWatch

A good-looking, feature-packed watch, but it doesn't have the battery life to claim an award

SCORE ★★★★★

PRICE £146 (£175 inc VAT)
from pcworld.co.uk

Three things single out the ZenWatch from its Android Wear brethren: a lovable old-school style, a lack of physical controls, and a large AMOLED screen. In fact, the display isn't much bigger than that of the Sony SmartWatch 3, nor is the 320 x 320 resolution any different, but its 296cd/m² luminance levels, deep blacks and rich colours make it easier on the eyes in all conditions other than bright sunlight. Notifications are more legible, and you can see greater detail when navigating with Google Maps.

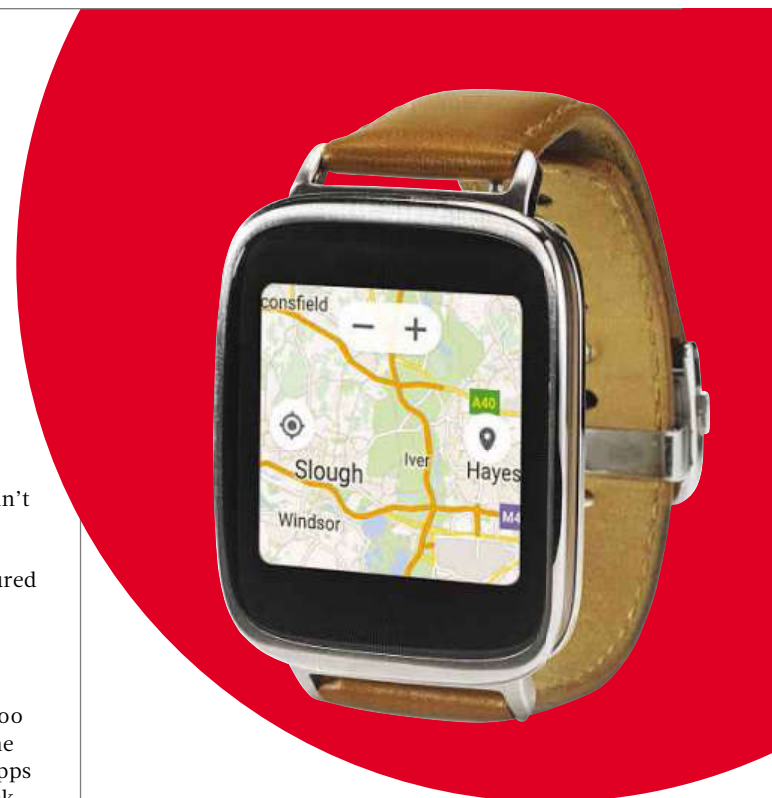
Despite its size, the ZenWatch is slim, light and very comfortable to wear. The hinged clasp holds the classy leather strap securely, and while it's not as tough or as

waterproof as other watches, it's dust- and water-resistant enough to allay any fears of it breaking. Throw in a selection of smart custom watch faces, and this is definitely one of the best-looking Android watches around.

The ZenWatch has a heart-rate monitor, but it's integrated into the bezel. Launch Asus's own Wellness app, and place your index or middle finger on either side of the bezel, and you can test your heart rate or run a bizarre relaxation test. While we wouldn't describe the latter as accurate, heart-rate measurements were within five beats of those measured using the Microsoft Band and Fitbit Surge. Sadly, the way it's implemented makes it all but useless for activity tracking.

With a 1.2GHz Snapdragon 400 processor and 512MB of RAM, the ZenWatch is very responsive. Apps launch quickly, and you can flick from function to function in an instant. We also like Asus' add-on extras, including a companion app for muting your Android phone and a remote shutter for the camera.

In fact, there's only one thing that lets the ZenWatch down: battery life. With a projected 30 hours in our tests,



ABOVE The huge AMOLED display is very easy on the eyes

it's the worst of any watch this month. One morning we put on the ZenWatch with 54% of the battery life remaining, and it didn't even make it to 3pm that afternoon. Keep it charged every day and it's a contender, but not durable enough to topple our award-winners.

Fitbit Surge

A worthy choice for fitness fanatics, but the Surge has too many failings as a smartwatch

SCORE ★★★★★

PRICE £145 (£174 inc VAT) from amazon.co.uk

Described as a “fitness superwatch”, the Fitbit Surge could do with a little slimming down itself. It’s a surprisingly thick, wedge-shaped unit integrated into a chunky rubber band and, while light and very comfortable, it looks dated. What’s more, there’s a surprisingly thick bezel around the 1.25in monochrome TFT touchscreen, which only makes the display look smaller. Throw in the fact that the transfective screen is rather dim when used indoors, and the Surge doesn’t look or feel all that super.

Neither is it much of a smartwatch. You receive texts and call notifications,

but that’s about it – there are no alerts for emails or events. This is a bit embarrassing when even bargain-basement smartwatches such as the Liquid Leap cram them in. If Fitbit has any sense, it will make better notifications a priority.

Beyond such disappointments, the Surge doesn’t fare badly as a fitness watch. You can swipe through the day’s basic fitness info easily, then flip quickly between the different modes to start and store data on an activity. Go for a run and it does a great job of tracking heart rate, steps, calories burnt and other relevant data. Heart-rate and activity tracking seems reasonably accurate, delivering beats per minute and step counts in line with those from the Microsoft Band.

The Surge’s biggest strength is Fitbit’s established fitness apps and systems. Goals and achievements encourage you to keep plugging away, and vibrating notifications when you reach a goal give you instant gratification. The iOS and Android apps are easy to navigate and beautifully designed, and there’s a nice balance between exercise stats,

Garmin Vivoactive

A so-so smartwatch, but a star performer when it comes to fitness-tracking features

SCORE ★★★★★

PRICE £136 (£163 inc VAT) from amazon.co.uk

Like the Fitbit Surge, Garmin’s Vivoactive is a fitness watch with smartwatch pretensions – but, unlike the Surge, it makes those features count. You’ll miss out on complex apps, voice-powered search, turn-by-turn navigation and the ability to dictate messages, but the Vivoactive doles out email, text, phone and event notifications, and you can expand it with apps and watch faces via the Connect IQ store.

The slab-like square design is humdrum but functional, and there’s nothing overweight or irritating about the design. The transfective LCD screen makes sparing but intelligent use of colour, and while the 205 x 148 resolution doesn’t exactly pack detail, it’s easy to read in all conditions. Most

importantly, the combination of taps, swipes and actual buttons soon becomes intuitive. You use the touchscreen to swipe through notifications or activities, but the buttons come in handy for, say, quickly pausing then restarting activity tracking.

The Vivoactive doesn’t offer heart-rate tracking, but it does work with ANT+ chest straps, and compensates further with excellent GPS. It’s quick to get a reading, and when you go on a walk, a bike ride or a run, it does a fantastic job. It tracks your route and monitors not just the obvious stuff, such as steps taken, average speeds and calories used, but more technical data, such as cadence. You can check it all out using the excellent Garmin Connect app, which rivals Fitbit’s for in-depth data and slick presentation.

After all this fitness goodness, the smartwatch side feels basic. Notifications are heavily truncated, acting mostly as a signal to pull out your phone. If you receive lots of notifications, you’ll soon find that there’s not much room in the queue; old ones are simply bumped out.

The Garmin’s other big selling point is battery life. You’ll comfortably see more than ten days of solid use unless you use GPS



ABOVE The Fitbit Surge is surprisingly thick, and looks dated

accessibility and fun. Sleep-tracking features are particularly strong, using heart-rate and movement data to analyse and highlight patterns.

For all the Surge’s failings as an attractive timepiece and smartwatch, we like it as a fitness band. However, despite its lack of heart-rate monitoring, we like the Garmin Vivoactive even more.



ABOVE The Garmin Vivoactive measures technical fitness data such as cadence

frequently, which can sap the battery within eight hours. For most people this won’t be a problem, and Garmin’s simple, clip-on cradle makes it easy to top up as and when. It’s only a half-decent smartwatch, but it’s an absolute belter of a fitness device.



Design your own watch face

You don't have to settle for the selection of watch faces that come preinstalled on your smartwatch. Here's how to create your own

One of the joys of owning a smartwatch is having the ability to change your watch face. Have a classic chronograph look one day, a digital face the next, some fancy animated face after that – it's like wearing a different watch every day. The Pebble and Android Wear stores are packed with custom faces covering everything from retro styles to Hello Kitty, and even Garmin's Vivoactive can use alternative faces, courtesy of the Connect IQ store.

What if you want to build a watch face from the ground up? Well, depending on your smartwatch, there are tools available to do just that.

■ Apple watchOS

Bad news if you want to make your own Apple Watch faces – Apple has decided to maintain tight control of

watch-face design, rolling out only ten faces in watchOS 1. Some of these can be customised extensively, however, with different colours, animations, complications (Apple's watch-face widgets) and layouts from the watch-face gallery. Force Touch your current watch face, swipe left and right through the alternatives and you'll see a Customise button beneath each option. Tap it to start customising.

Sadly, some watch faces are barely customisable at all. It's clear that Apple's focus is on maintaining a coherent style and optimising battery life – it's no coincidence all the faces have black backgrounds – but that won't cut any ice with those who want to tailor their watch. Apple is promising greater control with the forthcoming watchOS 2.

■ Android Wear

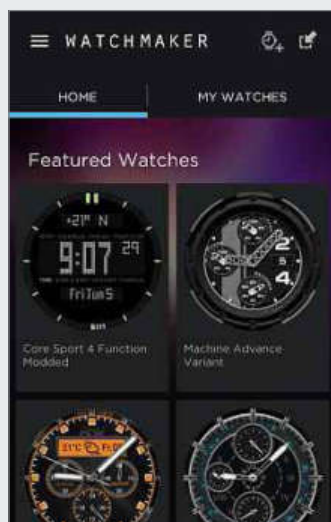
Of all the major smartwatch operating systems, Android Wear is the most customisable, partly because Android Wear and the hardware support more colours, more visual options and higher-resolution displays.

Several watch-face design apps are available, all of which will run on a connected Android phone or tablet. Facer offers serious levels of control, down to background images and the exact font, size, colour and placement of every portion of the time and date, but the interface is bewilderingly complex, and building your own watch face will be too much hard work for most.

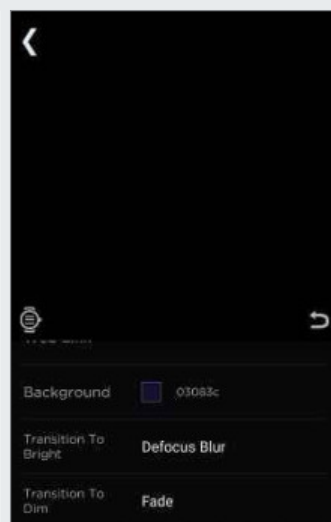
WearFaces is a little easier to get your head around, but positioning the time and date involves trial and error,

“Of all the major smartwatch operating systems, Android Wear is the most customisable”

Build a watch face for Android Wear with WatchMaker



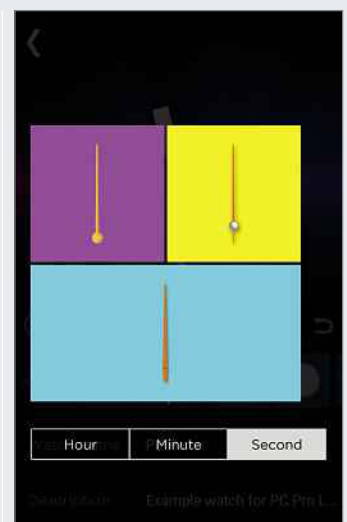
1 Launch WatchMaker and go to the homescreen. Now tap the icon with the watch symbol and the plus in the top-right corner to design a new watch. Now tap the Design Watch button.



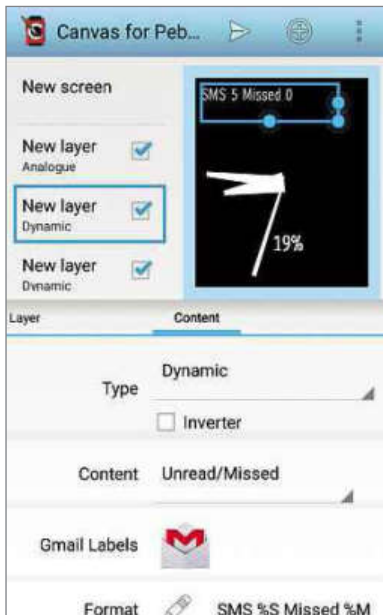
2 Scroll down to give your face a name and enter a description. Then, more importantly, set a background colour and the transitions from Dim to Bright and Bright to Dim. Bear in mind that with many watches using a bright colour will have a negative impact on battery life. Now scroll back up and tap the + button to add your first layer.



3 Swipe left to right to see the different types of content you can add to your new layer, then tap on one to drill down further into the options. Here we've tapped on Watch Backgrounds, then on the Scenic category.



4 Obviously, you'll need watch hands or a digital display so that your watch face tells the time. Here we're going for an analogue style, so we need to add three watch hands, tapping on the Hours, Minutes and Seconds buttons at the bottom to make sure that we get one hour hand, one minute hand and one second hand.



while the user-configuration options are rather limited – it's more a vehicle for downloading and customising some brilliant WearFaces watch-face packs than a serious tool for producing your own.

Our favourite Android Wear option is WatchMaker. The free Watch Face version is fairly limited, with many of



ABOVE LEFT You can achieve sophisticated results with the Canvas for Pebble app

ABOVE RIGHT Great watch-face packs for Android are available via the WearFaces app

With WatchMaker, however, it's easier to resize, reposition and customise each layer, and the built-in components are more stylish and functional.

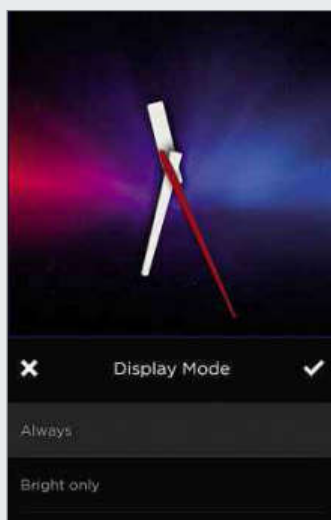
■ Pebble

The Pebble's community-led, DIY-friendly ethos mean that

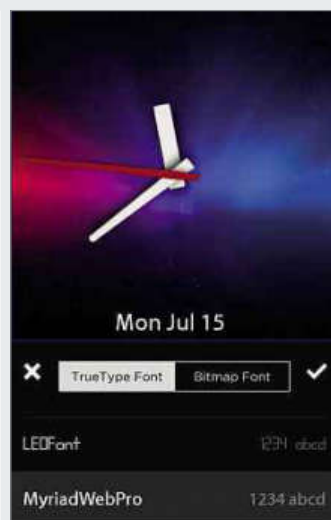
the better customisation features locked, but pay the very affordable £1.99 for the Premium version and you can import your own graphics and add a multitude of widgets to your watch face. As with Facer, you build up your new watch face layer by layer, with a different component – the hour, minute or second hand, a weather widget, a battery gauge – on each layer.

custom watch faces are very much on the cards. You can actually code your own; there's a good tutorial available at pcpro.link/253watch. Alternatively, you can use the online Watchface Generator tool (watchface-generator.de), although the version for creating colour Pebble Time faces is currently a preview. This allows you to design your own face – complete with different analogue and digital styles, text, background images, and battery and connection status widgets – using simple dropdown menus and sliders. It's surprisingly flexible, and the wysiwyg editor ensures that you get reliable results.

There's also an Android app, Canvas for Pebble, where you can build your watch face layer by layer, adding new layers for analogue or digital time plus battery, SMS and email indicators. What's more, it's extendable through plugins, although only Now Playing music and Notification plugins are currently available. It's a fairly complex app with a slightly idiosyncratic way of working, but as the preinstalled Canvas faces demonstrate, you can achieve sophisticated results.



5 Once a layer is added, you can scroll down to edit its attributes, including size, position, alignment and colour. You can also set whether that layer appears in the dim mode when the face is set to Always On mode, or whether it appears only when the watch face is bright. To save battery life, only have the most critical elements – the time and possibly the date – visible while dim.



6 To add a date, add a new layer and find the date category. You can set the date format by tapping on the down arrow in the Text box, and set other attributes such as the font, size, position and colour by scrolling down to the different settings.



7 You can add extra components (such as a weather widget or a battery meter) by adding layers and choosing from the elements provided. Be careful with sizing and positioning – it's quite easy to position components incorrectly. You may also need to reorder your layers so that, say, the watch hands remain on top at all times. To do so, tap and hold on a layer's thumbnail, then drag it left or right.



8 Finally, you'll want to export your new watch face to your watch. Tap the back button in the top-left corner, then tap the green Set Watchface button at the bottom. One quick sync later, and your watch will have a brand-new face.

Microsoft Band

Big on fitness, but not so strong on style, and its smartwatch features are limited

SCORE ★★☆☆

PRICE £133 (£160 inc VAT)
from pcworld.co.uk

The best thing you can say about Microsoft's design is that it's tough and utilitarian. The worst? That it looks like you're wearing an electronic tag. Still, while the Microsoft Band might make you look like a young offender, it's comfortable when fitted properly, using the ratchet clasp to get a good, tight fit around the wrist.

This is primarily a supercharged fitness band, and the amount of data the Band collects is impressive. Between UV monitors, galvanic skin sensors, accelerometers, gyroscopes and an optical heart-rate monitor, the Band is busy both while you're

exercising and while you're going about your everyday life. Even the sleep-tracking features are extensive. While a chest-band heart-rate monitor will generate more accurate results, readings from the Band were very close to those from the Fitbit Surge and Apple Watch. Using Microsoft's Health app on Windows Phone 8.1, there's plenty to get your teeth into.

The Band has a lot of smartwatch features, accessed through a range of tiles you can install from the Health app. Messages, emails, events and more are up for grabs, and you can also use the Band to talk to Cortana on your Windows phone. It's great when it works, and Cortana keeps getting better at dealing with reminders, quick emails and local search. The interface is deliberately simple and intuitive, and the Band doesn't bite off more than it can chew.

However, the small screen, while bright and clear, only has room for three lines of text, so notifications are cut right back. Other features prove frustrating – asking Cortana for directions or information sends you back to your phone, for example. We also had difficulty getting notifications



ABOVE The Band collects an impressive amount of fitness data

to work reliably, both from a Lumia 735 running Windows 10 Mobile Insider Preview and a Lumia 820 running Windows Phone 8.1.

Battery life is good at a projected 53 hours, we love the Band's welcoming cross-platform approach, and it's keenly priced. We only wish that the hardware were more attractive and the software more functional.

Motorola Moto 360

A decent smartwatch lies beneath the bling, but performance and battery life have been bettered

SCORE ★★☆☆

PRICE Light gold, £208 (£250 inc VAT)
from o2.co.uk

Motorola was the first smartwatch manufacturer to deliver a round watch, and while the Moto 360 now faces competition from LG, it's still one of the best-looking Android Wear devices. Not everyone will like the large 1.56in face, the 49g weight or the bling of our sample's light gold strap and finish, but in its black and silver versions it's a comfortable, elegant timepiece.

It's strong in other ways, too, packing in a heart-rate sensor for health apps and an ambient-light sensor to control the screen's brightness. The larger screen size and 320 x 290 resolution means both a black strip at the bottom of the display and a lower pixel density than the LG

Watch Urbane, but it's crisp and very bright – we measured maximum brightness levels at 508cd/m². Google Now cards, emails and notifications are all easy to read, and the microphone does a fine job with Google Now and dictating texts or emails.

Android Wear has improved significantly since the Moto 360's launch last year. It's easier to access apps, you can use wrist gestures to scroll through notifications, and maps and navigation now work much more effectively. What's more, Motorola's own Moto Body app makes the most of the accelerometer and heart-rate monitor to track steps and cardio data, watching for signs that you're exercising and logging the results. Those looking to boost their fitness rather than do proper training may find it's all they need.

Unfortunately, the Moto G falls down in a few key areas. Battery life is mediocre – even in our light-use tests we measured around 38 hours – and the 360 feels sluggish. It's not exactly unresponsive, but the 1GHz TI OMAP 3 processor is clearly struggling with the workload, and that will only increase with future Android Wear revisions. Rival smartwatches flick



ABOVE The Moto 360 is still one of the best-looking Android Wear watches

from function to function with noticeably more snap.

The Moto 360 is worth considering for its price, particularly if you avoid this overpriced gold version, but it's no longer the leader of the Android pack.

Pebble Time

Not the most elegant smartwatch, but it's fun and the battery life is stellar

SCORE ★★★★★

PRICE £150 (£180 inc VAT)
from firebox.com

Pebble has won a sizable userbase by focusing on core smartwatch features and handling them well. The Pebble Time might have the luxury – for a Pebble – of a colour display, but it hasn't lost sight of the ethos. If a long battery life, useful apps and at-a-glance notifications matter most to you, this is a great smartwatch.

It won't be to everyone's taste. The Time is simple and solidly built, but the thick bezel is hardly elegant, and in some ways the styling's a step backwards from the grown-up Pebble Steel (a Steel version of the Time is imminent). The screen is colour, but a limited resolution and colour palette

mean that everything looks like it belongs on an old 8-bit PC. It's telling that the Pebble's best watch faces – and there's a growing selection – embrace a kind of knowing retro cool.

The Pebble prioritises function over form. There's no touchscreen, but everything can be done through three buttons on the right and one on the left, and basic operations soon become intuitive. The polysilicon e-paper screen is actually more legible in bright sunlight, and the backlight kicks in when alerts arrive.

The Time handles notifications well, mirroring them as they arrive on your Android or iOS phone. You can reply to texts with ready-made responses, or dictate a short reply using the microphone. And while the Time might not have all the built-in functions of Android Wear watches or the Apple Watch, there are apps to cover most bases, including a healthy selection of fitness, walking and travel apps – Runkeeper, Stroll and TripAdvisor are all on board. Many feel primitive, however, and not all work reliably: TripAdvisor and Stroll occasionally refused to connect to the phone in our tests.



ABOVE The Pebble is a great smartwatch, although it won't be to everyone's tastes

The Time's biggest strength is battery life. With a projected runtime you can almost measure in weeks, it's streets ahead of every other full-fat smartwatch here. Even in heavy use it should last five days. This isn't the most desirable or high-tech watch, but it is one of the most usable. Provided you can live with its looks and limitations, it's well worth £180.

Sony SmartWatch 3

The bargain of this month's group, delivering decent performance and excellent value

SCORE ★★★★★

PRICE £94 (£113 inc VAT)
from amazon.co.uk

Sony's Android Wear smartwatch hasn't got the best styling, the strongest feature set or the sharpest, brightest screen, but it almost claws its way onto the winner's podium through value. This is a good Android smartwatch with reasonable battery life, fine performance and a decent screen for well under £150.

It's a simple design, with the core watch module available in a choice of a thick rubber straps, more lightweight sports housings and premium metal bands, all available in two colours. Our black rubber version isn't exactly glamorous, but it feels solid, comfortable and robust, with a secure folding clasp. There's just one button on the right-hand side to wake the watch up, with most other

actions handled through the large 1.6in touchscreen. Given the work Google has put into making Android Wear more intuitive, that's all you need.

The screen itself has its plus and minus points. On the one hand, it's a transreflective TFT, which makes it more usable than the Asus ZenWatch or the LG Watch Urbane in bright sunlight. Its size and the 320 x 320 resolution also make it easy to read notifications and check your location on Google Maps. On the other hand, the display looks dimmer indoors than those of other Android watches. We measured maximum brightness at 281cd/m², and that doesn't reflect the obvious blue/purple cast. It's nothing we can't live with, but if you want a screen with "zing", look elsewhere.

The same might apply if you want fitness features. The Sony has no built-in heart-rate monitoring, although it does have GPS.

Otherwise, the SmartWatch 3 works brilliantly as a vehicle for Android Wear 5.1. With a 1.2GHz ARM Cortex-A7 processor, it feels slick and snappy, and navigating through the various notifications, cards and apps is prompt. The microphone works well when dictating replies to texts and



ABOVE The transreflective screen performs better outdoors

notifications, or sending queries to Google Now. Battery life isn't up to the level of the Watch Urbane, but it's well above the ZenWatch and Moto 360. Want an affordable way to climb on the wearables bandwagon? The SmartWatch 3 is it.

Continued from p81

a heart-rate monitor. Some have an ambient-light sensor to vary screen brightness according to conditions, while some incorporate built-in GPS. Those that don't can still piggyback on the location sensors in your phone, but those that do can track routes and distances even when you don't want to lug your phone around. Great for a keen runner, for example.

The other major differentiator is battery life. Some smartwatches last several days or even weeks without a recharge, while others – in practice – need charging every day. That's not as much of a pain as you might think if you build it into your routine, but there are implications for the battery's long-term longevity.

Software

Beyond the proprietary firmware used on the fitness watches, there are four operating systems on offer. Pebble has its own OS. It's simple, easy to use and reflects the company's independent,

community-led ethos, with a large selection of watch faces and apps. The Microsoft Band runs on a custom version of Windows Embedded, but is very focused and accessible, while playing surprisingly well with iOS and Android. However, customisation options are limited and third-party apps are non-existent.

Android Wear and Apple's watchOS are the biggest players, with Android Wear bound into the Android ecosystem and watchOS tied to iOS. While watchOS's App Store is stronger, both contain companion apps for many major apps and services.

The mistake people make when buying a smartwatch is that they expect it to do something amazing in itself, but they work best when you get them working with the systems, apps and services you already use. They're brilliant for checking your email, sending and receiving short

texts, and navigation. They can help you get nearer to your fitness goals. They're also great when used with to-do list, note-taking and communications apps. We suspect that this is just the beginning, and that the killer app for smartwatches is just around the corner.

How we test

We paired our watches with a range of iOS, Windows and Android phones, using them every day in our working lives, while bringing in activities to test their fitness-tracking, local search, communications and navigational skills. We also tested battery life using *PC Pro*'s standard tests, setting each watch up to receive regular notifications, then analysing how much charge was consumed over five or more hours to project a realistic maximum running time. Where possible we also tested the screen brightness using a colorimeter.

“Smartwatches work best when you get them working with the apps and services you use already”

View from the Labs

There is no more subjective piece of technology than a smartwatch, says **Stuart Andrews**, but don't get saddled with a poor performer

Let's face it, barring Google Glass and the kind of high-tech adult toys we're not too keen to review in *PC Pro*, technology doesn't really get more personal than this. That means that a smartwatch that looks and feels right to one tester doesn't always look and feel right to a colleague. Software that's intuitive to someone from an Android background feels less intuitive to someone coming from iOS.

In fact, in most respects you already made a choice about your smartwatch when you bought your smartphone. If you bought an iPhone, Android Wear watches are off the table. Likewise, the Apple Watch is dead to anything but an iPhone (and even then you'll need an iPhone 5 or above). Only Microsoft, Fitbit, Acer, Pebble and Garmin cater for both iOS and Android users – and if you prefer Windows? Well, we hope you like the Microsoft Band's distinctive style.

In the end, five devices stand out for different reasons. The Pebble Time doesn't look stunning or feel high-tech, but its retro cool and sense of fun are infectious. The Garmin Vivoactive is a barely adequate smartwatch, but



Stuart Andrews is a regular contributor and former *PC Pro* reviews editor

“In most respects you already made a choice about your smartwatch when you bought your smartphone”

a belter of a fitness device. The Sony SmartWatch 3 is more middle of the road than driving your Ford Focus to see James Bay play Milton Keynes, but it's a very cheap and capable Android Wear device. When it comes to class, features and performance, the LG Watch Urbane and Apple Watch Sport come out on top.

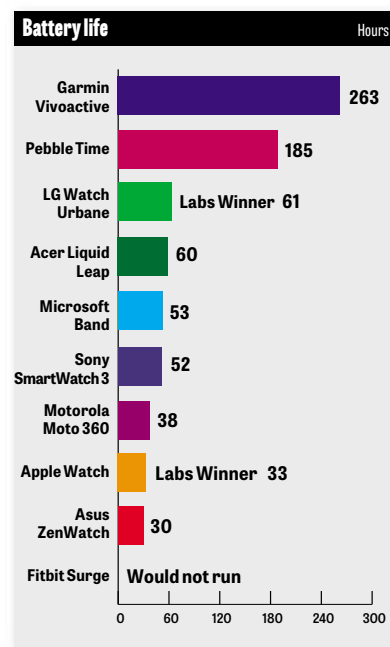
On paper, the Watch Urbane is the heavy hitter; its battery life is better and it's an easier sell on value for money. The Google Now-focused Android Wear is a much cleaner and more intuitive UI than it used to be,

and everything from getting directions to dictating emails is handled with aplomb. Yet you can't deny Apple's design sense and attention to detail in the Apple Watch Sport.

It's light and comfortable to wear and a real pleasure to use. Sure, it's arguably overpriced, but that hasn't held back the iPhone, the iPad or the MacBook family. People don't buy Apple products because they outperform the competition, but because they prefer the way they

work and feel. Here, the same applies. Neither watch is perfect, but each shows a category moving forwards with confident strides. ●

Test results



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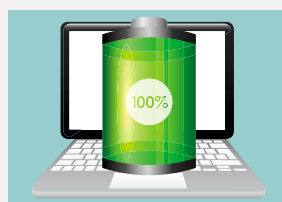
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Xbox One: the perfect companion for your PC

Microsoft's console isn't just about front-room gaming. We show you how the Xbox One can be a versatile media centre, an app platform and a streaming hub for your home.



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Bill Gates at 60

As William Henry Gates III enters his seventh decade, we look back over a remarkable life, rounding up Bill's achievements – and some of his more shameful moments.



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The Network



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BUSINESS FOCUS

Choosing the right A4 colour laser printer

Dave Mitchell tests the lasers that turn out fast, high-quality prints at a price to suit your business



The paperless office is still a pipe dream: most offices simply can't function without facilities to print documents, reports, invoices and more. And despite the challenge from inkjets, the laser still reigns supreme. Laser printers are faster than inkjets, cost less to run and have fewer moving parts, which means they're less likely to break down.

For SMBs looking to handle their printing in-house, the good news is that high-speed colour lasers are now almost as affordable as mono printers. Colour quality is easily good enough for professional reports, giving businesses a lot more versatility, and laser toner isn't so picky about paper quality either.

This month we round up four colour lasers from the biggest names in the market. We review their features and test their quality and speed to help you make the right buying decision.

Driven to print

Laser printing hasn't seen much in the way of major innovations in the past couple of years. However, HP's new LaserJet Enterprise models do improve toner design and reduce power consumption, and one of the models in this guide uses white toner

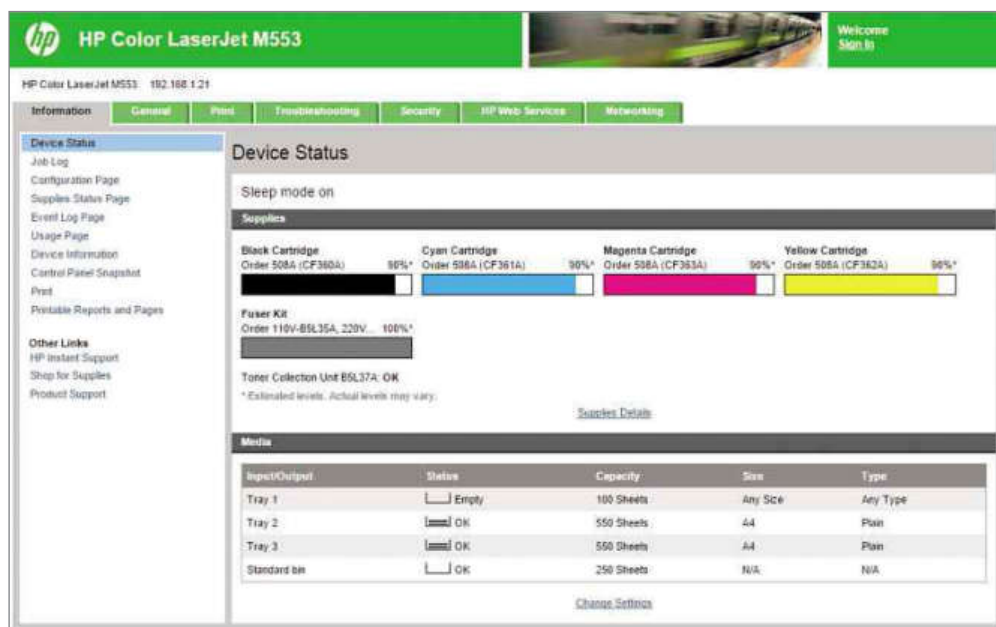
to bring laser printing into the garment-printing market.

For your business it's probably more important to focus on the standard features. Network support is standard on most lasers, but troubleshooting issues can be a nightmare for IT support departments, and you don't want to have to teach users how to manually install and configure

a driver. Look for models that offer network discovery and auto-configuration.

Also consider the type of driver you'll need. For general office printing, PCL5/6 drivers are perfectly sufficient, and provide plenty of control over the printing process. Features vary across different vendors, but most offer resolution and colour

BELOW HP's JetIntelligence tells you how many pages are left in each toner cartridge



controls, duplex printing, booklet printing, printing multiple document pages on one sheet and more.

If graphics quality and accurate colours are important to you, a printer that supports PostScript will be a good choice. As PostScript drivers do all the page rendering on the computer, they can be slower than PCL drivers, but are more suitable for maintaining consistent quality when the same document is printed on different devices.

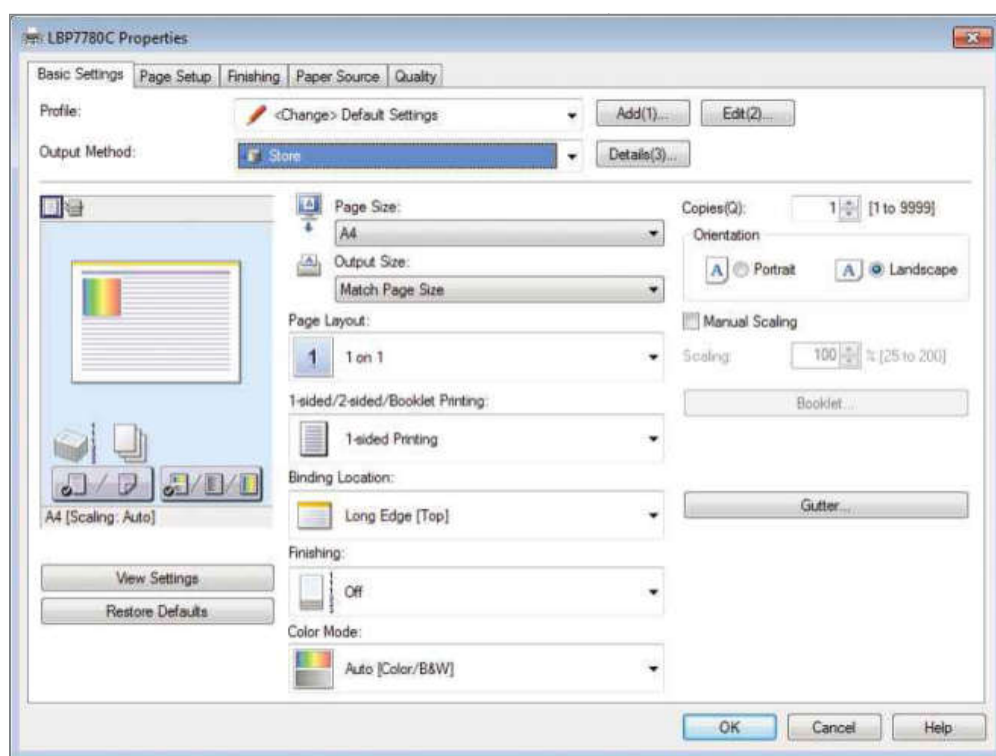
Running costs

When choosing a laser, don't be seduced by a low purchase price. Vendors claw back these savings by making consumables more expensive; in a high-demand print environment, this can increase running costs massively. For example, the printers we test this month can deliver mono and colour pages for as little as 1p and 7p respectively: step down into the sub-£150 market and running costs can climb to 3p for a mono page and 12p to 14p for colour.

Some printers also come with a choice of toner cartridge capacities. The high-yield versions deliver the best running costs, but you won't get these included with the printer, which at best will come with standard-yield cartridges included. Many are shipped with "starter" cartridges that offer only half-capacity, so you could find yourself ordering more toner earlier than expected – check the data sheet to see exactly what you're buying.

Dare to duplex

When a 500-sheet ream of paper costs less than a fiver, it's tempting to allow users to print to their heart's content. But if this gluttony isn't controlled, it can have a big impact on your budget. Duplexing can halve your paper costs in one swoop,



making it a must-have feature for high-volume printing.

Printers with a duplex unit do cost more, but buying one upfront is cheaper than adding it as an option later on. Most vendors have cottoned on to the appeal of duplexing and often set their drivers to default to double-sided printing. Users can also specify this option from their driver panel – but, equally, they can turn it off. It would be great to be able to force users to print in duplex, but we've yet to see a business laser offering this feature.

With colour at their disposal, users may also be tempted to print personal documents and pictures. If you don't want your business paying for this, look for printers that can block them from using colour, or limit the number of colour pages they can produce.

ABOVE Adding an SD card to Canon's LBP7780Cx lets you store documents on the printer

"The good news for SMBs is that high-speed colour lasers are now almost as affordable as mono printers"

BELOW HP's and Brother's network-discovery utilities neatly automate driver installation

Tour of duty

How much do you expect your new printer to be used? We suggest you estimate your expected monthly print volume, then choose a printer with a recommended (not maximum) monthly duty cycle that is two to three times

more than that. That way, when demand increases, the printer won't break down from overuse.

Speed is important, too. Many sub-£400 lasers can muster print speeds of

up to 35ppm in monochrome, but can they do this for more demanding colour prints? On the pages that follow we use a wide variety of mono and colour prints to get an overall measure of printer speed.

On that point, we don't believe that timing a print run from the moment the application's print button is pressed is necessarily the most informative measure; this obscures the difference between the time the printer takes to heat the fuser and the speed at which it can churn out pages once it gets going. Where appropriate, we provide a time to first page, as well as a measurement of the speed of the laser once it's printing.

The printers on review offer a wide range of features, speeds and paper-handling capabilities, and are priced to suit different-sized pockets. Read on to see which one suits your needs best – or, in the case of the Oki printer, takes your business in new and unexpected directions.





Brother HL-L8350CDW

Poor colour speeds and average quality, but a good-value printer with great mobile support

SCORE ★★★★★

PRICE £195 exc VAT from
printerbase.co.uk

Small businesses looking for a feature-packed colour laser will have an eye on Brother's HL-L8350CDW. For less than £200, it offers both wired and wireless printing, a claimed 30ppm print speed and top-notch mobile device and cloud support.

AirPrint is enabled by default, and it only took a minute to link the printer to our Google Cloud Print account, via a quick registration service on the well-designed web interface. Using Brother's iPrint&Scan iOS app, we could then print directly from our iPad's camera roll, iTunes file sharing, a web page and even straight from the camera. The latest version supports iCloud, Google Drive, Dropbox, Evernote and OneDrive, and we had no problems logging in to our Dropbox account, remotely viewing our files and printing them.

Brother provides worthy security measures, too: enabling the secure function lock allowed us to create up to 100 PIN-protected user accounts. We could set a page-count limit for each one, and decide whether they were allowed to print in colour, or to use the printer's USB port.

After we disabled colour printing for some users, colour-mode jobs



simply wouldn't print for them. They didn't receive an alert on their PC, although a warning message flashed up on the printer's display panel. They could only print by selecting the driver's mono setting.

The web console detailed the number of pages printed by each user, and we could set a lock on the printer's control pad to stop them fiddling with settings. Alas, Active Directory authentication isn't supported: if you want this you'll need to step up to Brother's 9000 series of lasers.

Users can also secure their own print jobs by assigning a PIN from the driver panel. They can then walk up to the printer, select their name from the display panel and enter the PIN to release the job.

Quoted print speeds proved achievable for mono prints. Our 30-page Word document was delivered in 58 seconds; in duplex mode it completed at 14.5ppm. The

ABOVE The printer has some useful security measures, such as the ability to PIN-protect jobs

"It only took a minute to link the HL-L8350CDW to our Google Cloud Print account via the printer's well-designed web interface"

time to first page was between nine and 12 seconds, extending to 20 seconds when the printer had to wake from deep-sleep mode. Colour proved more of a challenge: frequent pauses while printing our complex 24-page DTP document dropped the overall speed to only 10ppm.

The HL-L8350CDW is a noisy printer – each page is heralded by a cacophony of whirrs, clicks and clunks – and output quality is variable. Text is pin-sharp, and the Brother handled the tiny 0.1pt and 0.2pt gaps between blocks of black well; however, we found mono photos lacking in detail and marred by banding, and we could see little difference in quality between the driver's 600dpi and interpolated 2,400dpi settings. Colour printing was better: although banding was still evident, colour photos were vibrant with good levels of detail. Reports with large graphics were equally eye-catching, and our colour chart showed smooth transitions across complex fades.

Brother offers three capacities of consumable: standard cartridges yield very high print costs, with mono and colour pages working out at 2.2p and 13p respectively. The extra-high-yield 6,000-page cartridges drop mono and colour costs to a more acceptable 1.6p and 8.2p per page.

While Brother's HL-L8350CDW loses points for average print quality and slow colour speeds, it remains a tempting choice for small businesses. It offers plenty for a low price, and Brother's mobile and cloud printing features can't be faulted.

SPECIFICATIONS

600 x 600dpi A4 colour laser • 30ppm colour/mono • 400MHz CPU • 128MB RAM (max 384MB) • 2 x USB 2 • 10/100 Ethernet • 802.11n wireless • duplex • 250-sheet drawer • 50-sheet MPT • monthly duty cycle, 750-4,000 pages • 410 x 486 x 313mm (WDH) • 22kg • 1yr on-site warranty

RUNNING COSTS

Extra-high yield: K toner (6,000 pages), £59 • C,M,Y toner (6,000 pages), £132 each • drum unit, (25,000 pages), £113 • belt unit (50,000 pages), £70 • waste bottle (50,000 pages), £13 • overall cost per A4 page: mono, 1.6p; colour, 8.2p

LEFT Brother supports wired and wireless modes, but not simultaneously



Canon i-Sensys LBP7780Cx

The controls are limited, but that's offset by fast print speeds, good output quality and low running costs

SCORE ★★★★★

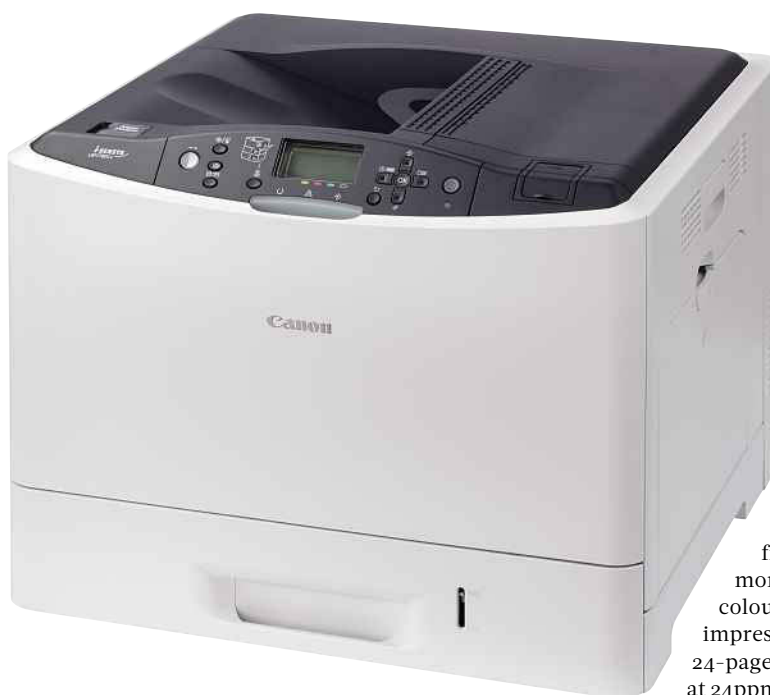
PRICE £362 exc VAT from printerbase.co.uk

Canon's flagship A4 laser, the i-Sensys LBP7780Cx, is one of the more expensive workgroup models on the market – but over time it pays for itself with low running costs. Add in 32ppm colour printing, a fast duplex speed and a beefy recommended duty cycle of 5,000 pages per month, and you have a laser geared up for print-hungry users.

It's well built and, although its user interface isn't exactly intuitive, the control panel and monochrome LCD display are clearly explained in the user manual. Gigabit Ethernet comes as standard, but wireless support requires an optional TP-Link TL-WA890EA external Wi-Fi adapter, which costs around £24.

Canon's discovery routine makes installation easy, and while the web management interface looks dated, it gives a straightforward view of the toner cartridges, waste bottle and paper trays, along with a list of detected errors.

From the Settings page, you can alter the deep-sleep timer and set the printer to shut down at a specific time every day. Network settings such as FTP access can also be configured, although almost every change



requires the printer to be power-cycled before it takes effect.

The LBP7780Cx's weak suit is security: all you can do is create a list of IP addresses that permits access from specific workstations. You can't restrict colour printing for specific users, nor decide who can use the front USB port. Active Directory authentication isn't supported either.

Inserting a 32GB SD card into the slot next to the network port activates the Secure Print and Store driver functions. This allowed us to assign PINs to print jobs and store documents on the SD card for printing from the web console or the control panel.

Users without a printer driver can log in to the web interface and access the Direct Print option for PDF, PS, XPS and image files. You can also print files received by email or via FTP.

The printer supports Canon's MEAP (multifunctional embedded application platform), allowing it to

ABOVE Inserting an SD card activates Secure Print and Store driver functions

"No matter what we printed, the time to first page was never more than 11 seconds, and this printer won't cost the earth to run"

BELOW Canon's web interface shows the status of consumables, but offers very limited access controls

run custom Java apps. We tried to test this using Canon's Google Cloud Print app, but setup was so tedious it was quicker to add the LBP7780Cx to our account as a classic printer.

Print speeds are variable. Our 32-page mono Word document was delivered in one minute and, no matter what we printed, the time to first page was never more than 11 seconds. But colour speeds weren't so impressive: our complex 24-page DTP document printed at 24ppm, in both General and Publication driver modes.

The integral duplexer is a star performer, though. It took only 68 seconds to print our 32-page Word document – only eight seconds longer than single-sided printing. And this printer won't cost the earth to run; Canon's 12,000-page black and 6,400-page colour cartridges deliver

a mono page for 1p and colour for only 6.6p.

Print quality seals the deal, with razor-sharp text down to the smallest of font sizes and plenty of detail revealed in the darker areas of our test mono photos. Colour photos were equally detailed, with the driver's Vivid Photo setting producing vibrant colours with only faint banding, while the Presentation setting delivered high-quality colour reports.

The lack of user-access management and colour-printing controls counts against the Canon and its MEAP support will be of limited value to small businesses. However, it earns credit for its fast printing and duplexing, super output quality and commendably low running costs.

SPECIFICATIONS

600 x 600dpi A4 colour laser • 32ppm colour/mono • 768MB RAM • 2 x USB 2 • Gigabit Ethernet • 500-sheet input tray • 100-sheet MPT • duplex • monthly duty cycle, 1,250-5,000 pages • 517 x 530 x 401 (WDH) • 31kg • 1yr on-site warranty • Options: wireless adapter, £24 exc VAT; 500-sheet tray, £335 exc VAT

RUNNING COSTS

Mono toner (12,000 pages), £110 • C, M, Y toner (6,400 pages), £116 each • overall cost per A4 page: mono, 1p; colour, 6.6p

i-SENSYS Device Name: LBP7780C Product Name (Serial No.): LBP7780C(MMKA025606) Login User: System Manager Log Out Location: Remote UI: Portal Language: English Mail to System Manager

Last Updated: 08/07/2015 11:42:33

Device Basic Information

Device Status
The printer is ready.

Error Information
There is no error.

Consumables Information

Paper Information

Paper Source	Remaining Paper	Paper Size	Paper Type
Multi-Purpose Tray	None	A4	Free (Mixed Types)
Drawer 1	Loaded	A4	Free (Mixed Types)

Remaining Toner

Item Name	Remaining Toner
Cyan Toner	16-100%
Magenta Toner	16-100%
Yellow Toner	16-100%
Black Toner	16-100%

Basic Tools
Box
Direct Print

Management Tools
Service Management Service



HP Color LaserJet Enterprise M553x

An innovative colour laser that's big on features and ideally suited to SMBs that need high-volume printing

SCORE ★★★★★

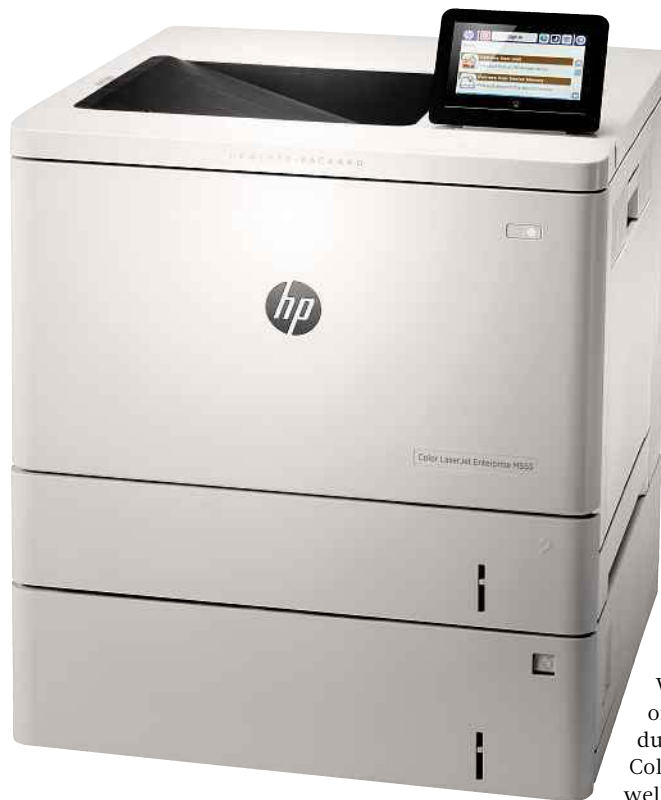
PRICE £648 exc VAT from printerland.co.uk

HP's M553 LaserJet family delivers a heap of new features that will appeal to SMBs and busy workgroups alike. These aren't minor tweaks: HP has redesigned these printers from the ground up.

The M553x is at the top of the range. The price may look steep, but you get plenty for your money. Along with a fast 38ppm print speed, built-in duplexing and a double-tray 1,200-page capacity, it offers Wi-Fi Direct plus near-field communication (NFC) – and it's the only one in the range to sport a large (10.9cm) adjustable colour touchscreen.

It also benefits from HP's new ColorSphere 3 toner. With its lower melting point, this allows the fuser unit to be made smaller, reducing the printer's dimensions. It also requires less power than conventional lasers, and HP's high-yield cartridges deliver low running costs of 1.2p per mono page and 7p for colour.

The cartridges show off HP's JetIntelligence technology, which provides more accurate measurement of toner capacities. The anti-fraud feature stops you from using cheaper refilled or third-party cartridges, but it does mean you can't



be ripped off, as the printer won't accept counterfeits.

It took us ten minutes to install, and it was easy to register the printer with HP's Connected service and assign it an email address for remote printing. We also registered it with Google Cloud Print, simply by entering the Connected email address.

With AirPrint enabled by default, we could print directly from our iPad, and securely log on to the printer using Wi-Fi Direct. There's an NFC touch point on the edge of the operator panel, but the M553x doesn't provide standard wireless AP services.

If it's the best user-access and colour-printing controls you're after, look no further. Support for LDAP and Active Directory lets you decide which features users can access from the web

interface, which also provides wizards to help set up authentication. Colour controls are extensive: you can limit this service to specific users and groups, or turn it off. Colour can even be removed for selected applications, although HP's user manual isn't particularly informative.

You get both PCL5/6 and universal PS3 drivers, which provide useful security measures. Jobs can be held at the printer until released, while "Proof and hold" lets you check the first copy before releasing the rest. Jobs can be stored on the 4GB hard disk, secured with a PIN and encrypted.

HP's claims of 38ppm printing proved bang on the money in our tests, with a 38-page Word document delivered in one minute single-sided. Even in duplex mode it took only 1min 15sec. Colour prints were handled just as well, with our 24-page DTP document averaging 38ppm at the highest 3,600dpi interpolated resolution.

The lower-power fuser means the printer warms up quickly: we never had to wait more than seven seconds for the first page from a warm state. The printer still put the first page out in less than nine seconds from sleep mode, and power consumption never went above 640W.

Print quality is excellent, with sharp text and detailed mono photos. Smooth transitions across the complex fades in our test chart resulted in detailed, vibrant colour

photos and graphics, with only a hint of banding present in large areas of solid colour.

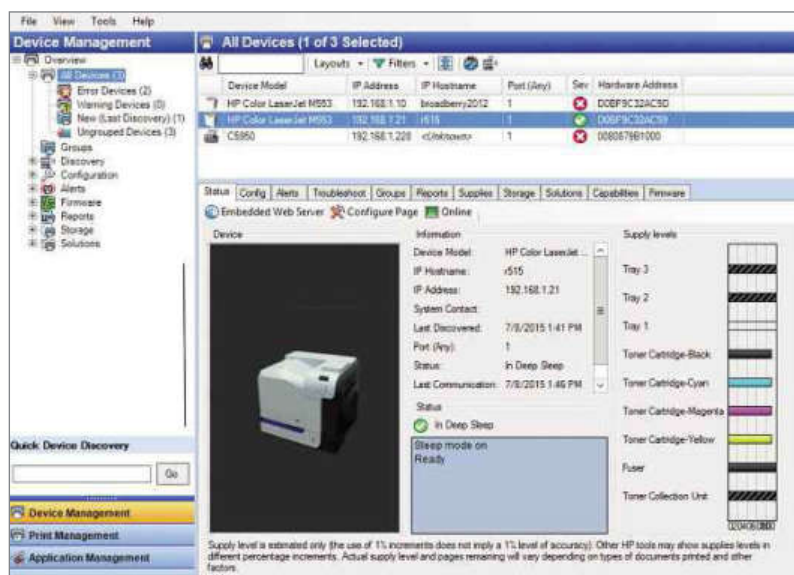
Businesses with big printing demands will find plenty to like about the HP Colour LaserJet

Enterprise M553x. This classy, feature-rich printer is fast and cheap to run, and won't be beaten for its extensive print-management tools.

ABOVE We never had to wait more than seven seconds for the first page to print



"Smooth transitions across the complex fades in our test chart resulted in detailed, vibrant colour photos and graphics"



LEFT The M553x can be remotely managed via HP's well-designed Web Jetadmin utility

SPECIFICATIONS

600 x 600dpi A4 colour laser • 38ppm colour/mono • 1.2GHz CPU • 1GB RAM (max 2GB) • 10.9cm colour touchscreen • 3 x USB 2 • Gigabit Ethernet • Wi-Fi Direct • NFC • duplex • 2 x 550-sheet input trays • 100-sheet MPT • monthly duty cycle, 2,000-6,000 pages • 458 x 479 x 581mm (WDH) • 1yr on-site warranty

RUNNING COSTS

High-yield: Mono (12,500 pages), £131 • C, M, Y (9,500 pages), £182 each • toner bottle (150,000 pages), £15 • 220V fuser (100,000 pages), £125 • overall cost per A4 page: mono, 1.2p; colour, 7p

EXCLUSIVE

Oki C711WT

An affordable entry point into the world of homegrown merchandise that comes with free training

SCORE ★★★★★

PRICE £1,995 exc VAT from themagictouch.co.uk

Oki's C711WT takes colour laser printing in a radically new direction: instead of black toner, it uses white. Clearly it's not designed for conventional print jobs: rather, it's intended to make producing in-house promotional merchandise and garment transfers a reality for SMBs.

The C711WT can print transfers for virtually any fabric item, including T-shirts, bags, badges, signs, diaries and coffee mugs. The ability to print white on black backgrounds also makes it ideal for creating blackboard menus for coffee shops or restaurants, as the transfers can also be used on wood and metal surfaces.

The C711WT is sold in the UK only by The Magic Touch (TMT), and there's a good reason for that. Oki's standard printer drivers are too basic for design work, so TMT provides the printer with its own SpaceControl software. To go with it, the company has developed a wide variety of transfer papers. It offers versions for white, pastel and dark fabrics, hard surfaces, and non-porous materials such as ceramics, glass and acrylic.

While the price of the printer is reasonable, for garment transfers you'll also need to factor in the cost of a heat press. We tested the C711WT with TMT's 2kW swing-head manual press, which costs £995. Weighing a



meaty 40kg, it's easy to use and maintains a steady temperature. For drinking vessels, you need a mug press: a single station model costs £199, but TMT is currently offering a free mug press with every printer purchase, and will extend this offer to PC Pro readers who cite this review.

To test T-shirt transfers, we imported our design into SpaceControl, tweaked the white settings and tiled them so as to make best use of the paper. For coloured garments, the background must be transparent: we used Photoshop to remove white backgrounds and saved the files into PNG format. Selecting the right paper type in SpaceControl automatically adjusts the image as appropriate.

The C711WT is ideal for transfer printing, offering a flat paper path. To print our transfer, we simply put

TMT's WoW mask sheet (msheet) in the manual feed tray and hit the SpaceControl print button. The msheet is then placed in the heat press and transferred to the transfer sheet (tsheet) which takes 50-60 seconds. After peeling away and discarding the msheet, we positioned the garment and tsheet on the press and gave it another five seconds of heat.

The last job is to place a silicon-coated new release paper (NRP) sheet over the image and press for a further 20 seconds, which bonds the toner into the fabric. It's a simple process, and our test T-shirt came out looking smooth, detailed and very professional.

SpaceControl only currently supports a direct USB connection to the printer, and worked fine with Windows 8.1. TMT advised us that network support is currently in beta and Windows 10 is also being tested. We found using the SpaceControl software and transfer processes very simple, and TMT also includes a one-day on-site training session in the price.

With the C711WT and heat press together costing less than £3,000, it's much more affordable than traditional direct-to-garment printers. It's an easy way of producing high-quality bespoke

marketing material, and could easily be used as a second revenue stream with no minimum order runs. Perhaps more to the point, it's the most fun you'll ever have with a laser printer. ●



"The C711WT is intended to make producing in-house promotional merchandise and garment transfers a reality for SMBs"

BELOW SpaceControl makes light work of producing transfers



SPECIFICATIONS

1,200 x 600dpi colour A4 LED • 533MHz CPU • 256MB RAM (max 768MB) • 34ppm • 2 x USB 2 • 530-sheet input tray • 100-sheet MP tray • monthly duty cycle, 3,000 pages • 435 x 546 x 389mm (WDH) • 28kg • 3yr on-site warranty

RUNNING COSTS

High yield: white (6K pages), £260 • C, Y, M (11,500 pages), £138 each • W image drum (6,000 pages), £122 • C, Y, M image drums (20,000 pages), £83 each • fuser (30,000 pages), £83 • transfer belt (30,000 pages), £65 • overall cost per A4 page: white, 7p; colour, 12p



Dell E525w

A cheap colour MFP with great output quality and cloud features, but with high running costs

SCORE ★★★★★

PRICE £219 exc VAT from dell.co.uk

Dell is shooting for the cloud with the E525w, a colour laser MFP that reaches out to mobile users. It supports Wi-Fi Direct and AirPrint (but not NFC), and has both wired and wireless 802.11n connections as standard – although they can't be used simultaneously.

With wireless enabled, we linked the E525w to our access point using its functional web interface. A WPS button is provided on the front panel, meaning we had no problems printing from our iPad via AirPrint. Dell's Document Hub iOS app allowed us to directly print files, web pages and Gmail messages, and even access the scanner. However, the app couldn't identify the printer or scanner over a Wi-Fi Direct connection, and would only work with AirPrint.

Driver installation takes only two minutes in Windows, and sets up Dell's Printer Hub app, which lists all local Dell printers, and the status of their consumables. It also ties in with Dell's Document Hub web portal, so you can scan straight to Dropbox, Box, Evernote, OneDrive, Google Drive and SharePoint Online cloud storage.

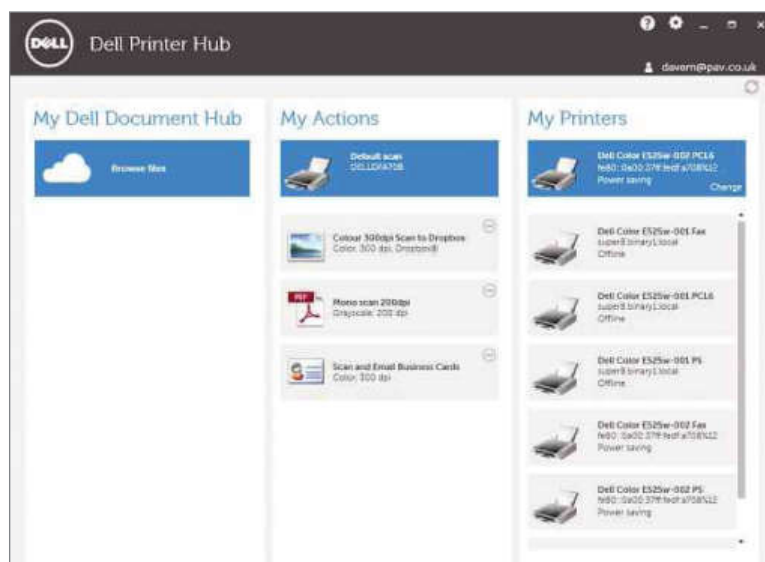
Accounts are set up by an administrator from the Document Hub portal and invitations are emailed

to users. After activating an account, logging in to the Printer Hub lets you browse and print files from – and scan documents to – the cloud. The Printer Hub lets you create any number of predefined actions, so local or cloud scans become a two-click operation. There's also an option to scan and OCR business cards to email as vCards, and save them to a contacts list.

Dell's Windows 8.1 Document Hub app provided quick access to our cloud storage accounts but, unlike Dell's C2665dnf MFP, the E525w doesn't let you print remotely from the Document Hub web portal. This means that you'll need Google Cloud Print to access it over the internet. The portal still has the free cloud OCR feature, for which Dell had previously threatened to charge extra.

Dell scores points for output quality: text is sharp, and mono photos show plenty of detail in darker areas. Our colour test chart revealed smooth transitions across complex colour fades, while colour photos and reports were vivid, superbly detailed and didn't display any noticeable banding. Scan quality is similarly very good.

The feature set is broad. You can scan directly to PCs, FTP servers and SMB shares, and there's a 100-entry address book for scanning to email and fax. You can disable or password-protect scan and fax functions, block



ABOVE Dell's Printer Hub simplifies scan operations and provides quick access to cloud storage

colour usage for copying and printing from USB drives, and use the driver to PIN-protect specific documents.

The E525w achieved its claimed print speeds in our tests, with our 18-page Word and 24-page colour DTP documents both being delivered at 18ppm. There's a long wait before printing starts, though: the time to first page was as high as 25 seconds for our large colour test print. Duplexing isn't automatic either: if you select double-sided printing, you have to print one side and manually flip the page over for the reverse to be printed. The scanner's 15-page ADF is slow too: a ten-page single-sided copy averaged only 6ppm.

Furthermore, printing costs are dear: mono works out at 2p per page, based on high-yield cartridge costs, while colour prints cost almost 11p. You'll soon need to buy your first

set of consumables too, as the printer only has 700-page starter cartridges.

Dell's E525w is a tempting proposition for small offices, as it offers useful cloud print and scan features. Its great print quality belies its low price, but the running costs and pedestrian copy speeds deny it our recommendation. **DAVE MITCHELL**

SPECIFICATIONS

600dpi A4 colour laser • 18ppm mono/colour • 1,200dpi colour scanner • 525MHz CPU • 512MB RAM • 2 x USB 2 • 2 x RJ11 • 10/100 Ethernet • 802.11n Wi-Fi • 33.6Kbits/sec fax/modem • 150-page input tray • 15-page ADF • monthly duty cycle, 250-700 pages • 410 x 440 x 353mm (WDH) • 1yr advanced replacement warranty

RUNNING COSTS

K toner (2,000 pages), £38 • C, M, Y toner (1,400 pages), £41 each • overall cost per A4 page: mono, 1.9p; colour, 10.7p

LEFT The E525w has a WPS button on its front panel and a functional web interface



EXCLUSIVE

WatchGuard Firebox M200

A high-performance security appliance delivering enterprise-grade protection at an SMB-friendly price

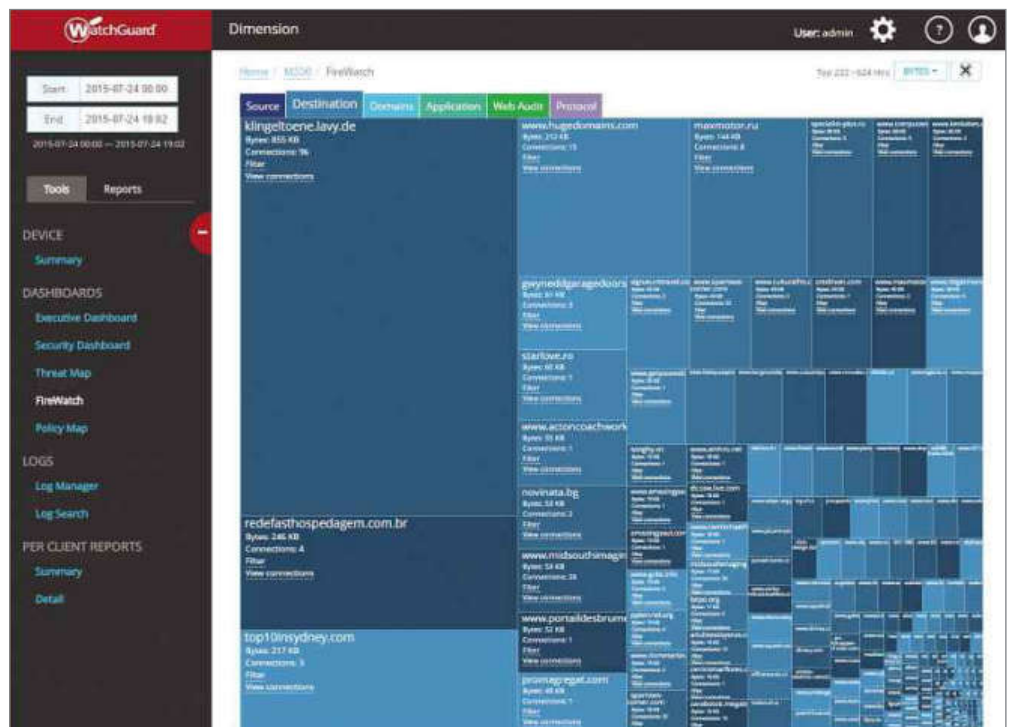
SCORE ★★★★★

PRICE With 3yr security suite, £2,548 exc VAT from watchguard.com

Premium security appliances don't have to be expensive. WatchGuard's Firebox M200 has a raw firewall throughput of 3.2Gbits/sec, eight Gigabit Ethernet ports and the same features as WatchGuard's Enterprise unified threat management appliances for only £2,548, excluding VAT. Along with a standard SPI firewall and support for IPsec and SSL VPNs, you get IPS, web filtering, anti-spam, Gateway AntiVirus and WatchGuard's reputation-enabled defence.

The M200 is a doddle to deploy – we had secure internet access for our LAN users in less than ten minutes. It defaults to mixed routing mode, allowing us to configure its ports as separate interfaces, with their own IP address and DHCP services. This meant we could give each network segment its own firewall policy, designating them as “external”, “trusted”, “optional” or “custom”. We gave each one a unique alias to use as network sources and destinations in the policies.

Proxies control HTTP, HTTPS, FTP, SIP, H.323, POP3 and SMTP traffic. These can be fiddly to set up, but the firmware helps, providing wizards for first-time configuration to clone predefined proxy actions and apply them to the security policy. You can choose on which proxies to enable Gateway AntiVirus, and set the M200 to decompress and scan archives. The optional advanced persistent threat (APT) blocker service costs an extra £845 for three years and applies to the HTTP, FTP and SMTP proxies. It scans incoming files for malware by



checking their MD5 hashes against the Lastline cloud service. The data-leak prevention (DLP) module is also worth considering, at £411 for three years. Applied to the HTTP, FTP and SMTP proxies, it blocks data such as credit card numbers from being transmitted.

The anti-spam wizard helped set up a policy to tag spam, suspect and bulk messages, and the transparent POP3 proxy meant there was no need to define internal mail servers. The WebBlocker filtering service has 130 website categories, allowing you to block or permit each one. The v11.9.6 firmware adds additional social networking categories, and tweaks performance. The latest v11.10 upgrade isn't available for the M200, so you don't get the new web interface sported by WatchGuard's bigger boxes.

The M200 is recommended for networks of up to 60 users, and gave a decent performance in our tests. With the appliance hooked up to the lab's Ixia Xcellon-Ultra NP load modules, the IxLoad control software reported a steady throughput of 1.2Gbits/sec for a basic HTTP packet filter policy, dropping to 700Mbps/sec with IPS enabled. HTTP proxies have higher performance overheads, meaning the

ABOVE WatchGuard's free Dimension software provides excellent monitoring and reporting tools



“The M200 is a doddle to deploy – we had secure internet access for our LAN users in less than ten minutes”

BELOW The M200 has eight Gigabit Ethernet ports and a raw firewall throughput of 3.2Gbits/sec

speed settled at 510Mbps/sec. Enabling IPS and GateWay AntiVirus saw this fall to 340Mbps/sec – slower than WatchGuard claims, but still good.

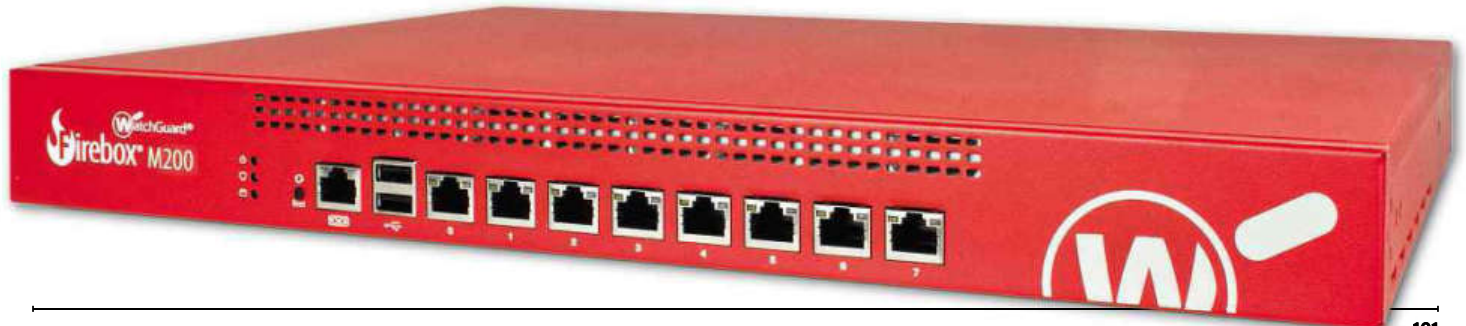
WatchGuard also includes free Dimension software. Offered as a Hyper-V or VMware VM, it monitors multiple appliances' traffic and user activity. Testing the VMware version was easy: we simply pointed the M200's Log Server service at the VM. Dashboards provide drill-down graphs, the Policy Map shows real-time traffic flows and the Threat Map shows where a threat came from.

We were unable to reach WatchGuard's speed claims in our real-world tests, but the Firebox M200

has a persuasive range of security features. It's ideally suited to SMBs that want the same network security as enterprises at a sensible price. **DAVE MITCHELL**

SPECIFICATIONS

1U rack chassis • quad-core 1.4GHz Freescale CPU • 2GB DDR3 RAM • 8 x Gigabit Ethernet • 2 x USB 2 • RJ45 serial • web-browser management • System Manager and Dimension software • hardware replacement warranty included





THE BUSINESS QUESTION

How can my business grow successfully?

Darien Graham-Smith asks the experts how a small company can identify and tackle the challenges that come with growth

Every small company hopes to grow – but as your business expands, it also changes. For example, you might find yourself needing to take on more staff, which in turn could require a move to a larger office. But growth isn't just about logistics: it also has implications for your technical resources.

■ Staying secure

Every company needs to keep its digital assets secure. However, when your business is just starting out, you probably won't want to worry about formal security policies. "Security is a lot easier to manage when there are fewer people involved," noted Jack Bedell-Pearce, managing director of data-centre specialists 4D. "If the business is just you and one other person, the potential for a security breach is minimal."

As your business grows, however, so does your exposure – and if you haven't had to worry about security before, it's easy to overlook. "It's one of those hidden risks that sneak up on companies," said Bedell-Pearce. "They manage well when they start off – especially if they're a technology company, where the founders all know about the dangers. But, as the business grows, they might hire somebody to handle the accounts, as well as non-technical people. A new employee might not know about tricks like phishing, and before you know it, they've been caught out."

There's no magic solution: you have to accept that, as your company grows and changes, security breaches will become more likely. This doesn't always mean investing in enterprise-grade security provisions, but you should ensure that staff have a basic

understanding of online security, including tricks aimed at naïve employees. "We do a lot of social engineering training," explained Bedell-Pearce. "We make sure that we're very careful to identify who we're talking to, and only give out information once we've verified their identity."

Another issue to consider is password security. With more people accessing networked resources, it becomes more likely that someone will choose a weak password, reuse a password across multiple sites, or reveal their credentials. You can reduce risks by using password-management software, which makes it easy for employees to use strong, unique passwords on every work-related site. There's an additional advantage: "When someone leaves, it makes the process of a mass-password change a lot easier", pointed out Bedell-Pearce.

A final consideration when it comes to security is Bring Your Own Devices (BYOD). This doesn't have to be a big technical issue, but it calls for foresight. "If people are using their personal mobiles to sync work email, make sure you've got a policy that requires them to put a lock on their phone," warned Bedell-Pearce. "That

sounds like pretty basic stuff, but once a phone is lost without a passcode lock, it can cause all kinds of problems. It's much better to introduce a policy from day one."

"There's no magic solution: you have to accept that, as your company grows and changes, security breaches will become more likely"

■ Social media and customer service

When your company is small, social media can be handled very informally. As you grow, you may find you need to start taking social media more seriously – and this may be where you discover that your business lacks the necessary expertise or manpower.

There's no shame in seeking external help. "It can often be a good idea to turn to an agency for support with your social media strategy," noted Melissa Wolfe, senior consultant at brand consultancy Blue Rubicon. Alongside benefitting from an agency's experience, outsourcing leaves your staff with more time to focus on their jobs. "Keeping up a social media presence might not sound like hard work, but doing it right means being constantly available and responsive," Wolfe pointed out. "Until your social media becomes essential for your customers, you don't want to be dedicating someone to the task full-time."

A similar principle applies to customer service. As your client base grows, it won't look good if your phone is always busy and emails go unanswered. "Some of our customers have benefited from using a managed call-centre service, which can be relatively inexpensive," revealed Bedell-Pearce. "So when someone calls you out of hours, or when you're busy in a meeting, another human can pick up the phone, say 'welcome to...' and take a message. It's a nice little touch that can make your company seem bigger."

■ Infrastructure

One practical issue that emerges as your business grows is the management of computing infrastructure to keep pace with

changing needs. However, this shouldn't divert resources from your core business.

"As our SMB customers grow, they want bigger, faster, more capable networks," said Tris Simmons, senior product marketing manager at Netgear. "But technology can quickly become a distraction as it becomes more complicated, or burdensome in terms of management time."

The first challenge is simply identifying what to upgrade. "When things are running slowly, typically the first thing people do is blame the wireless. But it could be the firewall struggling to handle too many connections at once," said Simmons. "Some businesses are throwing all their investment into 802.11ac infrastructure, but you have to ask what your users are doing: are they all streaming Netflix, or just connecting to internal networks?"

The answer may be to buy in expertise: "Consider a site survey from one of the big network providers," suggested Simmons. "That can be just about wireless, or you can look at all your switching and storage needs, and explore where you want to be in three or four years' time."

This doesn't have to be hard, and modern cloud technologies can help: "Let's say you've got a Netgear business router, and you need to install an additional wireless access point (AP)," said Simmons. "Once you put that AP in place, it 'phones home' and you can configure it via the cloud portal. You can install multiple APs, in multiple locations, and manage them all in the cloud. SMBs don't want to manage sophisticated controller hardware: it's cost-prohibitive, and too technical for most people. In the cloud you can define your AP, set up your SSIDs, define the clients



ABOVE Extending your network can be as simple as investing in a few new wireless access points

that can go on there and make the configuration changes you need."

The cloud also helps with business-critical services. "A decade ago, when your business expanded, you didn't really have many options, other than investing in a dedicated server," recalled Bedell-Pearce. "The cost of installing Exchange, and setting up a file and print server, was all hugely expensive for a small company."

"Now you've got the cloud, and

you can use VMs to run a lot of these services relatively cheaply. You can outsource things: you don't need to set up your own Exchange server; you can buy virtual Exchange boxes for three

or four pounds per month. It opens up a huge amount of functionality without the capital expenditure."

In short, as your business grows, you can benefit by taking advantage of the independent services that are out there, so your staff can concentrate on what's important. "Focus on the things that your company is good at," advised Bedell-Pearce, "and outsource everything else you can." ●

"In the cloud you can define your AP, set up your SSIDs, define the clients that can go on there and make configuration changes"



The expert view Steve Cassidy

If I had to single out one thing that distinguishes businesses that grow successfully from the rest, it would be a culture of

scepticism. Without a doubt, you can learn lessons by looking at what other companies are doing, and by listening to what the experts are telling you. But the greatest opportunities rarely arise from simply copying what everybody else seems to be doing at the time. A questioning outlook to which technologies need upgrading, or what needs hands-on management and what can be safely outsourced, can save you from getting bogged down in expensive and time-consuming distractions that ultimately do nothing for your business but make it harder to manage. That doesn't just apply in times of growth, of course, but

it's particularly important when your resources are becoming stretched and *some* change is necessary to keep the business on an even keel.

Contrary to what some vendors will tell you, it may be that the solution to your needs isn't more technology, but quite the opposite. One friend and client attempted to encourage staff in his growing business to get organised by banning Post-it notes. The idea was to get them to think about better places to keep the information they were forever scribbling and sticking up on their monitor surrounds. In practice, this one simple idea caused the business to grow a forest of databases for trivial purposes, such as a list of missed calls and a list of passwords. Not only had the fairly skilled workforce rediscovered local PC database applications – in this case, FileMaker Bento – it had

also started using more than one cloud backup service, once it became apparent that their brute-force first-generation backup wasn't playing well with their database of choice. It's fair to say that staff were under no illusions as to the business value of these changes: the manager in question came out to his car on the first anniversary of the business to find it entirely papered with little yellow bits of paper.

Often it can seem like expert advice is monolithic – that one size fits all, and that any deviation from the template will lead to disaster. The most successful entrepreneurs I've seen and advised are the ones whose eyes narrow when they hear of a knee-jerk solution like "the cloud". Changing just one limitation in a business can have huge and empowering results.

Broadberry Server Storage

Choose the right storage technology
and give your business a boost

Server storage used to be about just getting as many hard drives as budgets would allow, and filling large noisy server rooms to the brim with enclosures to fit them in. These days there are many more technologies to ponder over: there's NAND flash or mechanical disk, SATA, NL-SAS or SAS interfaces, Fibre Channel, PCI Express and now NVMe to add to the mix – not to mention the environmental concerns of trying to keep vast server rooms cool. There's never been so many technologies to pick from – so it's never been quite so difficult to pick the right one. Let's run through some of what's available to help you make the right choice.

Performance – SATA vs SAS

The two most common protocols for moving data around server storage drives (both mechanical and SSD) are SAS and SATA. So what's the difference? SAS (Serial-Attached SCSI) is a point-to-point, full duplex (two-way) protocol that combines the intelligence of SCSI with the transport layer of SATA. It's twice as fast as SATA, with the current SAS3 protocol topping out at 12Gbits/sec as opposed to the

6Gbits/sec of SATA – and that speed difference will only increase in the future as the next protocol, SAS4 (due in 2017) is planned to run at 24Gbits/sec. Note that SATA drives can be plugged into a SAS backplane, but not the other way around.

SATA (Serial AT Attachment) is also point-to-point, but only half duplex (so data can be transferred in only one direction at a time). Although SATA is much slower than SAS, drives have traditionally been cheaper and more capacious. With the introduction of SAS SSDs, however, that situation has been somewhat turned on its head: for example, Seagate's 1200.2 series of SAS SSDs go up to 3.2 terabytes of capacity, with sequential read speeds of 1.8GB/sec. To get to these sorts of speeds with a non-SAS drive, you need to go down the PCI Express-attached storage path.

PCI Express

Solid-state drives that connect directly to the motherboard's PCI Express bus have been around for quite some time, and have the potential for huge bandwidth; unfortunately, they tend to have equally huge price tags. Even though these drives can offer significant

performance advantages, they've been held back until recently by their architecture. This is changing with the introduction of the NVMe (Non-Volatile Memory Express) architecture: built from the ground up to fully support NAND flash, NVMe is a low-latency scalable host controller with an optimised command issue/completion path, supporting multiple and higher queue depths. What that means in practical terms is that the CPU can be used to the full, allowing for much higher throughput.

Is NAND flash king?

The past few years has seen NAND flash-based products make huge inroads into the enterprise storage market at the expense of traditional mechanical drives, thanks to their huge speed advantage, lower latency, lower operating temperatures and lower power demands. Of course, all of these have to be weighed against the higher cost, compared to mechanical drives. Four different types of NAND flash may be found in a server storage environment: SLC, MLC, TLC and eMLC. SLC – **Single-Level Cell** – technology has been used extensively in enterprise storage because of its speed and



 **Broadberry**



longevity: an SLC drive may last as much as ten times as long as one using MLC NAND. It's the simplest form of NAND, storing one bit of data per memory cell, but the downside is its cost.

MLC – **Multi-Level Cell** – drives offer twice the capacity of SLC for the same die size, as they store two bits per cell. MLC drives are therefore cheaper to produce than SLC ones. They don't have the same lifespan, but recent advances in MLC technology have raised longevity to levels more acceptable for server storage, and MLC is beginning to take over from SLC. There's also a form of MLC known as eMLC – **Enterprise Multi-Level Cell** – which still uses two bits per cell, but is engineered for improved write endurance and a longer lifespan than standard MLC NAND.

The last variant is TLC – **Triple-Level Cell** – NAND. As the name implies, this stores three bits per cell, and is cheap to produce. There's been a lot of speculation about whether TLC NAND drives will have acceptable longevity, but that hasn't stopped Samsung introducing the PM853T, the first enterprise-class drive built around TLC NAND.

Capacity above anything else

Currently, if you want huge capacity at a low price, that's still the domain of the mechanical drive. But with the latest NAND technology to be put into production, the gap may close: 3D NAND can be manufactured in much higher densities than conventional flash, offering the potential for a huge rise in capacity for flash-based drives – far beyond what current mechanical drives can offer – without having to change the physical size of the drives. For

example, Samsung has recently unveiled a 16TB SSD in a 2.5in format, using 48-layer TLC 3D-VAND (Vertical NAND) technology.

Best of both worlds

While a storage solution based entirely on NAND flash can offer huge performance gains over conventional disks, it's also very expensive to implement. And depending on how you intend to use and access your data, it may not be necessary. If your need is for a greater I/O

“If your need is for a greater I/O density then a hybrid arrangement could be the way to go”

density than mechanical disks can provide, but there's no need for the very low latency of an all-NAND environment, then some sort of hybrid arrangement could be the way to go.

This is where SSD caching or Storage Tearing comes in. With SSD caching, the most-used data (known as “hot data”) is kept on an SSD for fast access, while data that is accessed less often (“cold data”) is stored on traditional SAS drives – or, if the budget is restricted, SATA drives. As an example, using four NVMe or regular SSD drives and 20 6TB SAS drives, you can achieve performance of more than 1,000,000 IOPS, and a capacity of 120 terabytes at a far lower cost than an all-flash solution. To achieve the same performance using mechanical drives alone would require around 5,000 disks!

Surveillance

While SSDs and other flash storage devices are relentlessly taking over from traditional mechanical drives in many areas, there's one place where there's no real need for the huge performance advantage they offer: the surveillance sector. Here, capacity and reliability are the priorities. Surveillance drives are also specially tuned for their role, as they must continuously write data to the disk and very rarely read from it.

Performance is, by comparison, a low priority: a compressed 1080p data stream has a data rate of around 2MB/sec – well within the capabilities of a mechanical hard drive. Even with the latest 4K surveillance systems that figure should only rise to around 4-5MB/sec depending on compression rates. Again, that's easily handled by a standard drive.

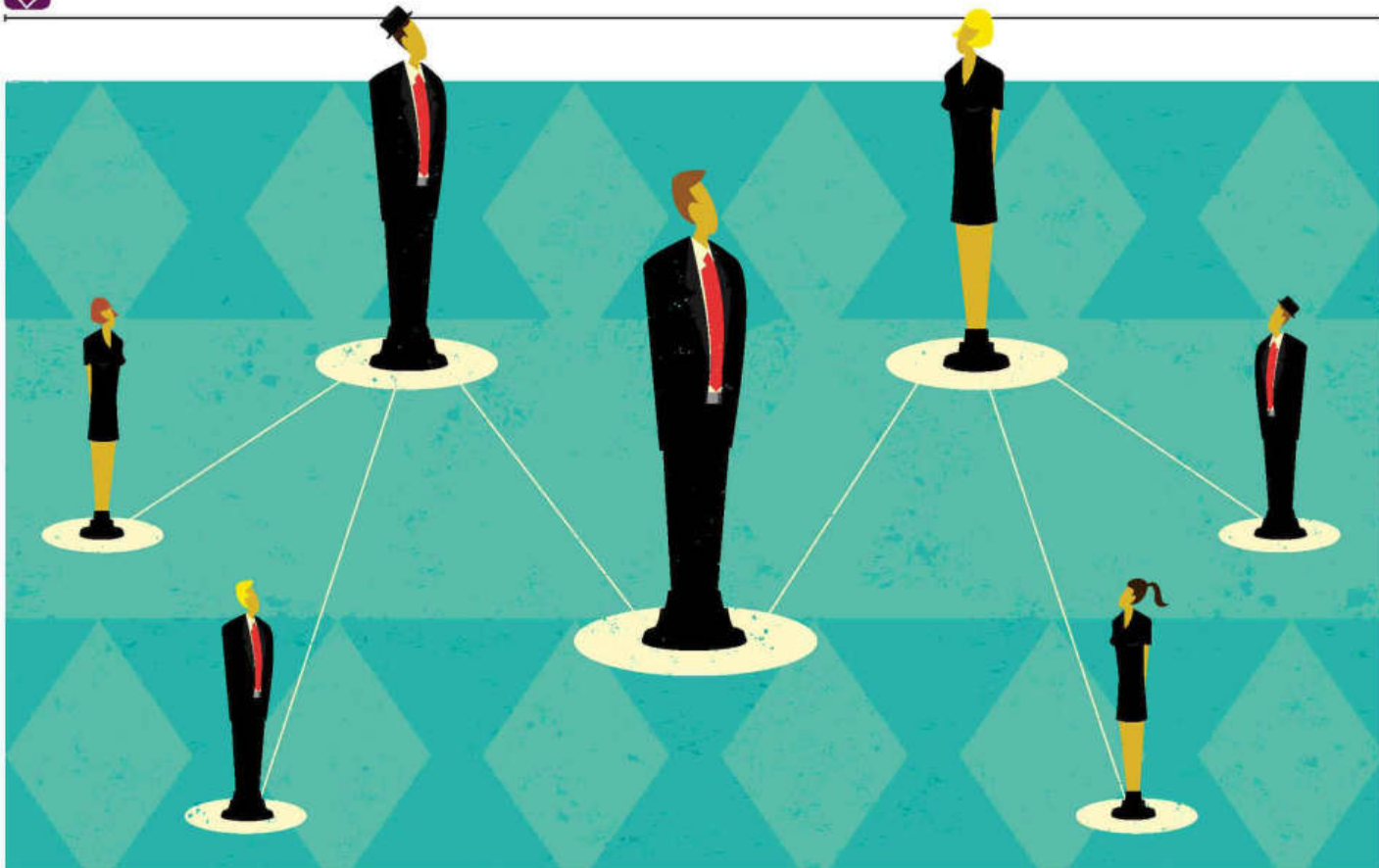
“SSDs are just too expensive”

Managers may worry that SSDs are too expensive to justify; but another way to look at it is to ask: can you afford not to use them? Whether you're looking at your total storage area or used hot data, if the need is to handle extremely high IOPS, then no other storage technology gets close to NAND flash. ●



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Build your business with LinkedIn

Darien Graham-Smith discovers how LinkedIn can help you find high-calibre staff, reach new customers and grow your business



LinkedIn is a unique networking site with more than 380 million registered users. The basic functions are free, so if your business isn't already signed up, you've nothing to lose by trying it out.

For many businesses, the primary value of LinkedIn is to find and engage new staff. "A lot of small businesses don't have a budget for recruitment," said Alex O'Connor, a recruiter at Dennis Publishing – the parent company of *PC Pro*. "If someone leaves or retires, the company might not have the budget to hire an agency to find the best replacement. LinkedIn connects you for free to a whole network of people who have an interest in your line of business."

But the benefit isn't just about cost, added Richard George, who is

corporate communications manager at LinkedIn. It's also about reach: "Five or ten years ago, if I was a small business wanting to hire somebody new, I needed to post an ad in the local press or in the trade press. Or, I might ask my network of suppliers if they knew anybody suitable."

"But when you're posting an ad, you have to hope that the best person for the job is actively looking. You have to rely on them seeing the ad and finding you, in order for them to get the job. Our data shows that only one employee in five is actively looking for a new job at any one time. So that's immediately 80% of people discounted. Your ad isn't going to reach them, because they're not looking for a job."

That matters because the ability to attract the right talent can make or break a small organisation. "If you're a small business, then you might be only hiring one or two people a year," noted George, "so one new hire could be a significant percentage of your workforce. It's hugely important that you find someone who's the right fit, with the right background and the right skills."

That's where LinkedIn can help – by enabling recruiters to get in touch with individuals who may not have been actively seeking a new role. "We probably fill 70% of our roles through LinkedIn," confirmed Leti Taylor, Dennis Publishing's resource manager. "We have some very niche roles to fill, and you may not get a suitable applicant. With LinkedIn, we can contact people who are aren't looking on the job sites – people who wouldn't have thought of applying until we approached them with an interest."

"Today there are more than 35,000 companies around the world using LinkedIn to find talent," noted George. "We call that part of our 'talent solution'." Making it work is simply a case of being active on LinkedIn, and building a network of connections so that you can find and

reach the right people.

"Just by having an active and up-to-date profile, and by growing your network, you can very quickly tap into a massive extended

"Just by having an active and up-to-date profile, you can very quickly tap into a massive extended network of people"

network of people who could be your next employee. Normal membership, having a profile on LinkedIn and growing your network is all free."

The final step is to persuade the individuals you approach to take you seriously. That means investing a little time and effort in your own presence on LinkedIn, to create the all-important first impression. "LinkedIn is mostly run by HR people," said Taylor. "If you have an HR team, those are normally the best people to be in charge of your company page."

"We make sure the company page is appealing," agreed O'Connor. "You can scroll through the first six or seven posts on the Dennis Publishing page and see the variety of our business." But that doesn't mean personal profiles can be neglected: "When we contact a potential hire," O'Connor pointed out, "the first thing they see is my profile. That immediately gives them a feel for the sort of people who work here."

If it sounds like LinkedIn opens the door to rampant employee-poaching, then that's sort of the point. But the Dennis HR team believes it ultimately helps employers and staff. "Headhunting will happen regardless," pointed out Taylor. "If someone's ready to move on, they're going to leave sooner or later. Think of a really big, successful company: the employees at IBM might not be planning to leave tomorrow, but they all know their key competitors. They know what their options are."

"But a happy person in the right role isn't going to leave – and every happy employee's profile is a window of advertisement, to attract others to come and work here. That's why our aim is to get everybody active on LinkedIn. Yes, there are threats, but the potential benefits outweigh the potential downsides."

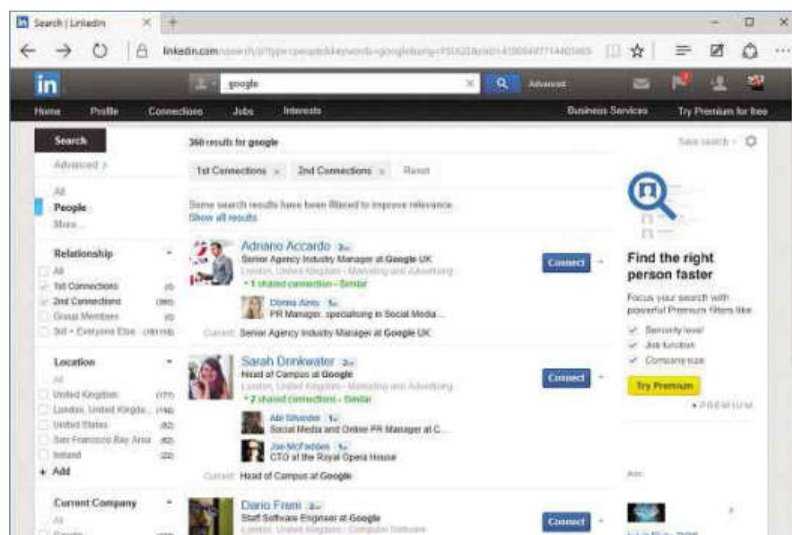
Promoting your business

While LinkedIn may be well-known as a recruitment tool, there's much more to the site than that. "A few years ago, LinkedIn was, pretty much, just a place to go if you wanted to find a new job," admitted Richard George. "But over the past few years we've put a lot more emphasis on relevant professional content such as industry articles, allowing people to share research and their own thoughts and experiences. Whatever role I'm in, whatever industry I'm in, I can come to LinkedIn and tap into all that shared knowledge and experience."

In other words, the site is growing into a general-purpose social network for businesses – and that means there's an opportunity to use it for promotion.

"LinkedIn helps you tell the right

RIGHT Identifying who's already known to your contacts helps you make a "warm" approach



people about your company," noted O'Connor. "It can help you make your small business look good. When you put the size of your company, you might be in the smallest category,

which is 0-50 employees.

People visiting your page don't know whether you've got two people or 20."

It can also be powerful for disseminating a marketing message. "Our

'marketing solutions' business lets companies put their messages and brands in front of the right people," explained George. "A lot of small companies want to use social media to grow and promote their brand, and that makes sense. But social media gives the buyer access to huge amounts of information, and decision-making powers: it's no longer the case that a company puts out a piece of business for tender and then everyone gets a fair shout at pitching for it. Increasingly,

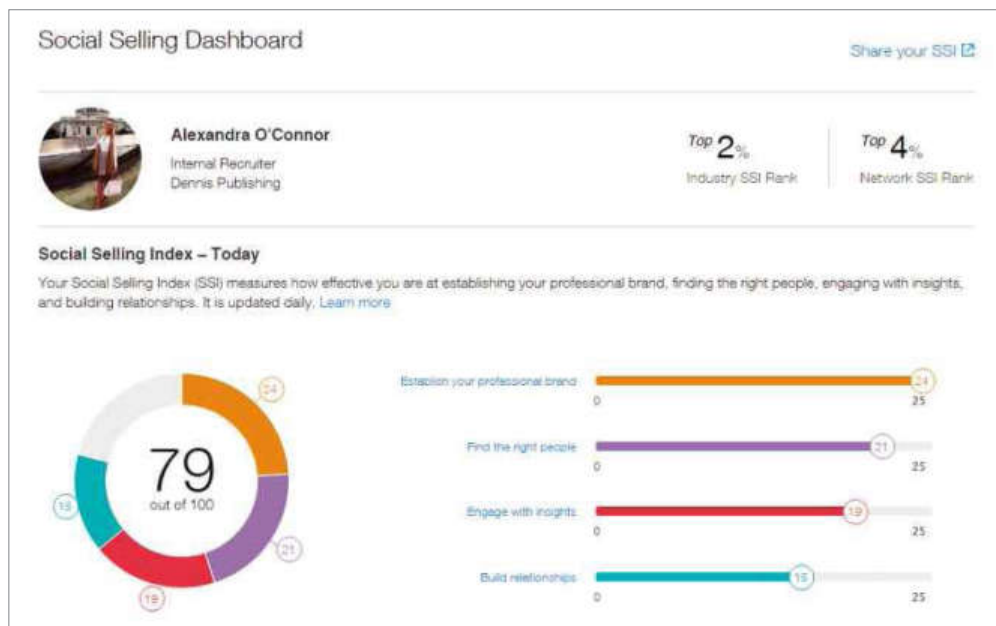
buyers and decision-makers can do their own research. They're 60% or 70% of the way along the decision-making process before they engage a supplier."

"So what's unique about LinkedIn is that it's all in a professional context. When somebody's on LinkedIn, they're doing their job. That means you can reach people when they're in that frame of mind, especially if you're in the B2B market."

"It's very different to Facebook," agreed Alex O'Connor. "Although companies do use Facebook professionally, it's seen as a personal service, and people don't like to spend too much time on it at work. Whereas with LinkedIn, people feel that because it's professional, it's got all the business content on there, they can keep the site open all day. So when we post something from Dennis Publishing, we find we get a lot more engagement on LinkedIn, between the hours of nine and five, than we do on any other platform."

"The site is now a general-purpose social network for businesses – and that means there's an opportunity to use it for promotion"

BELOW The Social Selling Index gives you a measure of how effectively you're using LinkedIn



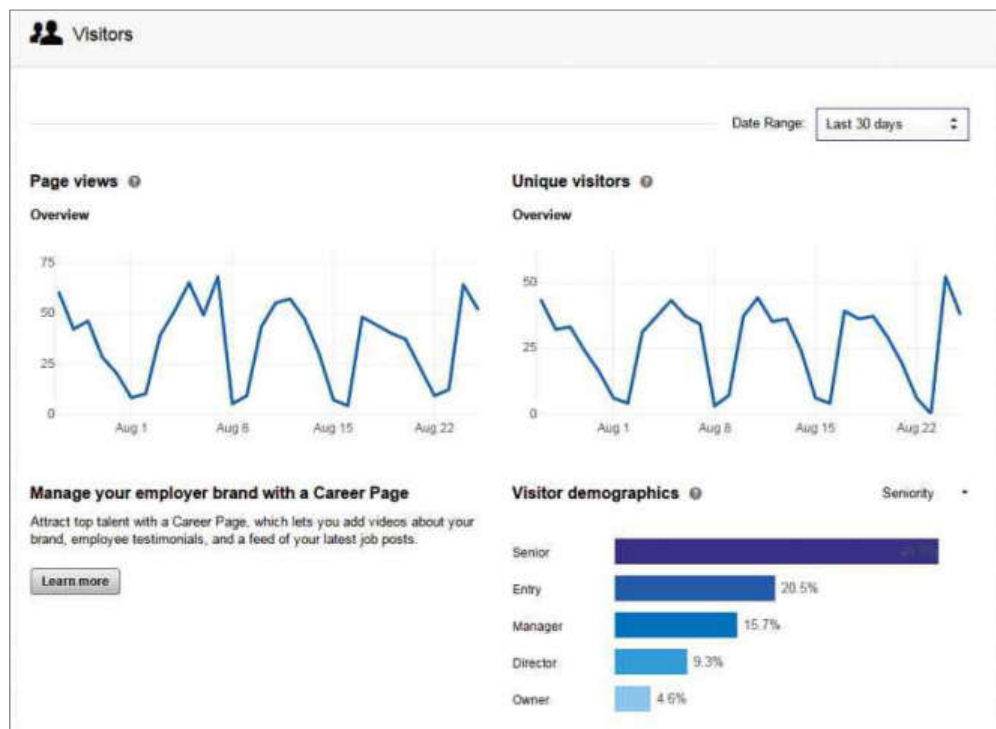
As well as distributing your message, LinkedIn helps you target it: “On your company page, you can see all sorts of analytics – who’s coming to look at your page, and see how big your reach is, and, if you’re putting out content, you can see what’s working well,” explained O’Connor. “For a small company’s that’s really great information. If 80% of your views are from a particular area or background then you know to target that area. For example, say you’re a boutique shop, you’d want to connect to people who worked at local businesses, and who might regularly walk by. It’s basically free business intelligence, and free advertising. Why not make the most of it?”

■ Making sales

So, you’ve used LinkedIn to establish your brand, and to refine your marketing strategy: the next step is to engage. But who exactly should you approach? “There are, on average, 5.4 decision-makers involved in every B2B decision today,” said Richard George. “So it’s a complex world for small businesses looking to sell to other businesses. There are more people they need to reach and influence in order to successfully make a deal. LinkedIn is a gift: it helps you identify the decision-makers inside an organisation. So you can make sure your message is getting to the right place.”

And that needn’t necessarily mean cold-calling. “With LinkedIn, you can identify people who are already in your network who might be able to introduce you to potential clients,” George continued. “Let’s say I’m in a small company of ten or 20 people: if I want to reach out to a particular prospect, I’m probably not directly connected to them. We offer a self-serve tool called Sales Navigator that can tell me if someone in my network knows them already, so I can have a warm introduction.”

“That’s really valuable, because all the data shows that warm introductions lead to better business deals. The buyer has a relationship of trust already, so the salesperson is able to build their own relationship more quickly. And you don’t need to be in a big organisation to use it – you can buy a licence for yourself if you’re a sole trader, and pay for it every month with a credit card. It’s a really easy way to start finding new clients.”



ABOVE Create a company page and you can track interest in your business

LinkedIn can even help you improve the effectiveness of your sales approaches. “We’ve recently announced our new ‘sales solution’,” noted George. “We looked at a group of successful salespeople on LinkedIn and created a scoring system, based on what the best practices are and what makes an effective salesperson.

That’s now available for free: you can go to the site and see what your score is, based on four measures of how effectively you’re using LinkedIn to promote yourself and your company. Over time, you can compare yourself

“You can identify people who are already in your network who might be able to introduce you to potential clients”

to your network and industry as a whole, which gives you an insight into how to do better.”

■ Growing your business

We’ve seen how LinkedIn can quickly benefit your business. What about the longer term? “If you’re a small business, LinkedIn is a great way to

see what your competitors are doing,” pointed out Leti Taylor. “You can learn from what they’re up to, and you can also look at larger companies – the ones that you want to be like in five or ten years’ time – and learn about what their focus is, and how they operate.”

“For example, when Dennis acquired buyacar.co.uk they were a team of six. In six months they had more than doubled, adding an extra ten people to their team, and were able to use LinkedIn to see how other similar companies had grown – as well as using the site to establish themselves as quite a cool online digital brand.”

“And, of course, it works both ways. When you go and look at who’s been viewing your profile, that’s not just about finding customers. It can also be very revealing when you see your competitors there. Say, one day, I open up our page and 79% of viewers are from – just as an example – H Bauer Publishing. You will know something’s going on: maybe they’re interested in something you’re doing, or something’s happened that’s made a lot of people think about moving.”

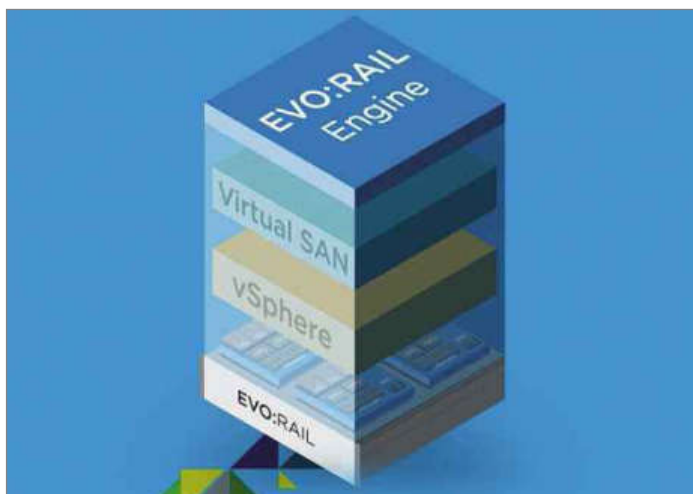
“There’s a lot you can get from LinkedIn, and you can even get training for free,” added O’Connor. “There are ‘webinars’ that can show you all the basics. It’s all really American, but then I think Americans do social media better than us Brits. LinkedIn is massive over there. Another one that’s huge is glassdoor.com, where employees rate the company they work for. We’re two years behind on that, but it’s coming – and it’s going to be just as big as LinkedIn.” ●

BELOW Posting valuable content can help build your profile

Preview	Date	Audience	Sponsored	Impressions	Clicks	Interactions	Followers Acquired	Engagement
[Image] Suffering from weekend bl...	8/24/2015	All followers	Sponsor	3,623	73	14	-	2.40%
[Image] It's #thumpday! The sunshin...	8/26/2015	All followers	Sponsor	418	17	4	-	5.02%
We are now looking to add to our te...	8/25/2015	All followers	Sponsor	1,407	11	5	-	1.14%
Happy #TechTuesday! We are lookin...	8/25/2015	All followers	Sponsor	1,483	12	4	-	1.08%
[Image] It's #MotoringMonday here a...	8/24/2015	All followers	Sponsor	3,831	30	10	-	1.04%
Magazine ADC: The Week celebrates...	8/13/2015	All followers	Sponsor	3,031	15	14	-	0.96%
Our cycling portfolio is looking for ...	8/12/2015	All followers	Sponsor	2,431	22	8	-	1.23%
BikesEtc, the UK's newest cycling m...	8/7/2015	All followers	Sponsor	2,066	11	9	-	0.70%

Hyperconvergence

It may sound like technobabble, but hyperconvergence might be the best approach, says **Steve Cassidy**



■ “Hyperconvergence?” Isn’t that just a meaningless buzzword?

Think of it more as a term of convenience. It’s shorthand for a specific modern situation in which different services, traditionally provided by disparate chunks of technology, converge into generic PC-based VMs. The move is, naturally enough, all about the money: back when your phone system came over droopy bits of bell wire soldered to little posts in your shed, and your network storage was accessed down shimmering fibres that cost £500 a foot, it was necessary to maintain separate budgets for them. Now they can all run on the same hardware, using the same types of wire, the same switches, the same controllers and the same web-based management tools – and the whole bundle can be much cheaper and more easily managed.

■ Does this mean you have to buy everything from the same vendor?

Sit in on a few sales meetings and you might think so. In fact, the main proponents of hyperconvergence are providers of virtualisation technologies – VMware is very hot on the idea, as is Red Hat. The important thing isn’t who you buy from, but getting the hardware right: there’s a basic set of requirements you must meet in order to qualify, and make no mistake, these are pretty recent standards. If you haven’t got a 10GbE switch and an OS capable of multi-pathed, multi-address NIC teaming, then things aren’t going to end well when hyperconverged services start sharing a wire with your regular traffic.

■ What services can hyperconvergence offer?

Two popular candidates for the technology are storage – not least because the servers acting as your VM hosts can also act as a farm (see *The jargon*, right) of disk space – and VoIP telephony. The latter is especially well suited, as it’s basically a PC platform anyway and has traditionally been a huge business cost. Other systems may be amenable to hyperconvergence savings, especially things such as CCTV – but there are often good arguments for keeping these separate so that when a disaster strikes, your eggs aren’t all in one basket.

■ Doesn’t this generic approach make it harder to specify and configure exactly the features and capabilities we want?

This is really a question about virtualisation: when it comes to hyperconvergence, the base unit isn’t a single VM server but a set of four or more of them. So when considering such concerns as machine

dedication, failover and upgrades, you simply use the orchestrator software (see *The jargon*, below) to tell the host how you want to handle things: if you can manage this for regular VM servers, you can do it for hyperconverged ones. Challenges might arise over things such as dedicated network cards for virtual firewalls or dedicated telephony systems for handling ISDN30 channels, but that doesn’t mean you have to throw out the whole concept: you can simply continue to use single physical machines where needed.

■ Will we still be free to expand our systems when the time comes?

Hyperconvergence hosts tend to be closed boxes: all your variety, expandability, new network protocols and everything else are in the VM guests. Members of the hyperconvergence farm have to meet the requirements of the hypervisor vendor, but they don’t have to be clones. The whole idea here is that the farm-management software (VMware vCenter, Microsoft System Center and so forth) knows enough about the speeds, sizes and abilities of the farm devices to handle load balancing – not quite automatically, but according to scenarios that you lay down. This shouldn’t be a problem as long as you’ve measured and understood the demands your business makes of its IT.

■ So when should we abandon conventional services and buy into hyperconvergence?

That’s a difficult question, as a period of upheaval will inevitably be involved. Very few businesses are in a position to hyperconverge their services over a handy Bank Holiday

weekend. One client I know waited for years until a particularly difficult IT manager retired – then, once they got in a new guy who was more comfortable with modern procedures, jumped ahead five generations. Another decided to hyperconverge when a business merger kicked off

an enormous overhaul in procedures, staff roles and technology. They figured that when the pace of change was already so fast, another source of confusion couldn’t make things much worse. In general, it’s one of those things that can be aspired to for years before it is finally achieved. ●

LEFT Replacing your telephone and storage systems with VMs may save your business money

“Very few businesses are in a position to hyperconverge their services over a handy Bank Holiday weekend”

The jargon

Host A physical server, or one node in a multi-host server farm. Hyperconverged architectures tend to use farms since this gives them greater flexibility to manage load and traffic.

Farm A collection of servers controlled by an orchestration and management suite, which together constitute a hyperconverged resource.

Orchestrator Software that responds to defined scenarios with

defined actions, such as migrating services to different physical locations according to load and environmental measurements. Not quite AI, but still pretty smart.

Software-defined something

A traditionally hardware-linked service – such as storage, networking, orchestration or traffic management – that’s now run by software. Of course, this has its limits: there has to be a physical infrastructure under there somewhere.



JON HONEYBALL

“Microsoft has to get its userbase onto Windows 10 to reduce customers’ dependence on previous versions”

Upgrading to Windows 10 allows you to tiptoe around the smoking crater of Windows 8, but give it a few months before taking the leap

It’s finally happened! It’s here! Fire up the marching band and get the party started! Windows 10 has shipped. Or rather, if some reports on Twitter are to be believed, it’s “escaped”. Without doubt, some users are having problems: I recently read about disk configurations getting so scrambled that you end up with an unreadable volume and all your data disappearing – something of an “oops”. Other people are reporting problems with multiple-monitor setups, many of which appear to recover after a reboot. There have also been some, to be kind, “suboptimal” driver releases.

All of this was to be expected. Anyone who installs a new OS on day one could definitely be described as displaying an abnormal degree of bravery. Microsoft knows this and has staggered its launch upgrade sequence to customers accordingly. Not everyone gets access to the update on day one, and nor should they. Throttling the deployment is a wise move that confines the initial round of problems to those who’ve proved most dedicated to the product over the past few months, as part of the Insider Programme. This makes it easy to say that anyone having problems has only themselves to blame, which, while perhaps true, is somewhat glib.

After all, there are two sorts of people in the world – those who have suffered a major data loss and learned from it, and those who haven’t – yet. Do we really, in 2015, need to have a conversation about how your computer blowing up, a catastrophic hard disk failure, loss of power supply, the OS imploding or leaving your laptop on the back seat of a taxi isn’t the end of the world? There’s more than enough good technology to keep your data safe: from cloud-based

solutions such as Dropbox or OneDrive to full image-recovery tools. If you don’t use them, you only have yourself to blame.

Nevertheless, I’ve already had numerous people asking me in my local pub whether or not they should upgrade to Windows 10. My answer to all of them has been a resounding “no!” That doesn’t mean they shouldn’t ever upgrade, just not yet. The initial rollout of a major OS upgrade always, but *always*, throws up problems that either weren’t encountered during testing, or were deemed to be of lower priority than meeting the release deadline. It happens time and time again, and there’s no reason why it would be different for Windows 10.

The free upgrade window for eligible users is a year, so there’s no need to rush to claim the offer. Take a month or two to see how the keen kiddies get on, before making sure you’re ready to take the leap. That involves checking that your full system recovery works and that a

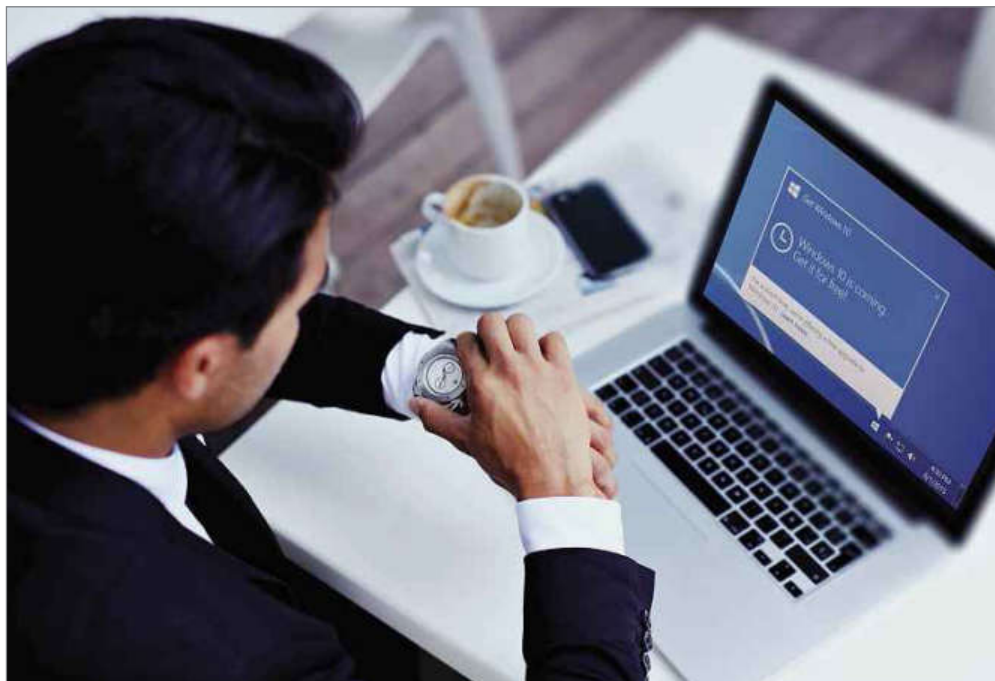


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complete disaster isn’t going to bring you out in an unwelcome sweat. As for myself, I’ve upgraded some test virtual machines, including a Toshiba Ultrabook that I don’t particularly like and for which I’ll shed no tears if it croaks and fails. I like what I see in Windows 10, but it’s certainly true that a lot of things came together very much at the eleventh hour (more like 11.30pm, actually). It’s the things that happened at 11.55pm that are the real worry, as late drops are always fraught with difficulty.

So I’m just letting the world take a few turns and will wait a month or so. If you want an in-depth analysis of the size of the new Start menu buttons, you’ve come to the wrong place. However, don’t mistake this initial hesitancy for indecision about eventually upgrading: Windows 10 has to work to become a success. Microsoft has to get its userbase onto Windows 10 to reduce customers’ dependence on previous versions. Windows 7 is a strong OS that’s still being sold on new computers – which

BELOW The initial rollout of a major OS always throws up problems, so there’s no need to rush





Jon Honeyball
Opinion on Windows, Apple and everything in between – **p110**



Paul Ockenden
Unique insight into mobile and wireless tech – **p113**



Robert Schifreen
Getting to grips with SharePoint – **p116**



Davey Winder
Keeping small businesses safe since 1997 – **p118**



Steve Cassidy
The wider vision on cloud and infrastructure – **p120**

is fine if you need it, but I would be pushing for hardware equipped with Windows 7 to be phased out. Everything you liked about Windows 7 is still there in Windows 10, so you can move forward and tiptoe around the smoking crater that was Windows 8. Timescale for upgrading? My recommendation is simple: get it within a year on all devices.

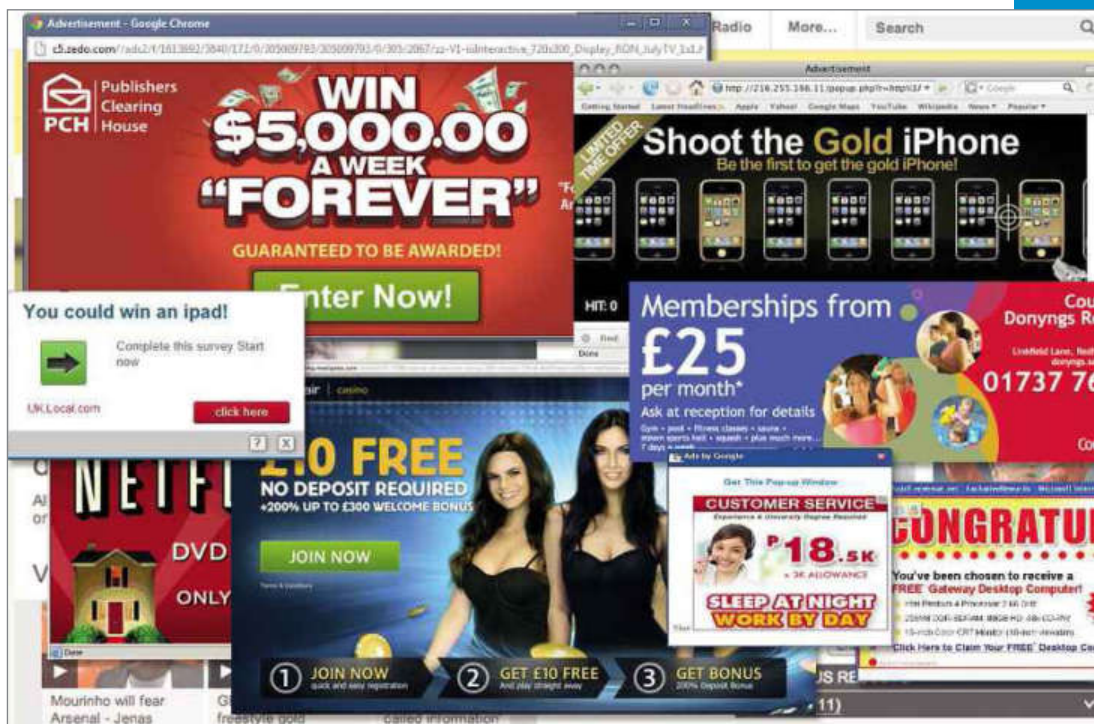
Here's why. I think that Microsoft has missed a real opportunity with Windows 10. I fully understand that it wants to get everyone onboard as soon as possible, which means accepting that an awful lot of baggage will be carried over. This is a good thing because, like it or not, baggage is what makes the computing world go round – users have favourite apps, companies have infrastructure, and hardware needs device drivers.

That said, I can't help but think that Microsoft has missed the opportunity to put a really rock-hard Windows 10 certification programme in place. It could help users identify not only bad code, but also newer versions or updates. After all, the problem for Microsoft isn't just that users stick to older OS versions such as Windows 7 and XP, but that they also hang on to older apps and don't update them as quickly as they could or should. Of course, it's not easy to persuade someone to hand over cash for a newer version of an application, when all they want is stability, not extra functionality.

I also have a special place in hell reserved for the printer vendors who won't sort out their device installations for Windows 10. Placing a firmware upgrader on your website, hidden deep below the Serbo-Croat recipe-writing add-on for your scanner software, isn't helpful. Most printers these days connect via IP and therefore should be able, at the very least, to tell me that new firmware is available. Even better, a modern printer should download and install the wretched thing itself. Discovering that out-of-date printer firmware is the root of all my printing problems is not a good way of getting me to buy your products.

Ghostery and ad-blocking

This is a difficult subject because *PC Pro* is a commercial venture and, if there's no money being made, the



doors will close. However, I'm getting heartily annoyed with websites filling my downloads with all sorts of tracking, marketing and advertising claptrap. In some cases, this can run to multiple items of code. For example, one motoring website I visit has code injected from AddThis, Flashtalking, Lotame, RadiumOne and Tealium. The *Guardian* website has AudienceScience, DoubleClick and ScorecardResearch Beacon. The *Telegraph* website uses Adobe Tag Manager, Chartbeat, Disqus, Google Analytics, NetRatings SiteCensus, Optimizely, Quantcast, Qubit Opentag, ScorecardResearch Beacon, Skimlinks and Webtrends. How many of those have you heard of? Are you happy for them to trundle away in the background, taking note of whatever's going on within your browsing experience?

Then there's the advertising junk. I understand that, without these annoying bits and pieces, there's no money and no money means no site. But the era of simple banners and non-invasive advertising has passed. Now we have pop-ups, pop-unders, banners and things that make us wait five seconds before eventually taking us to our intended destination. Or, you have to click to get rid of them, which is sometimes damn hard on a small smartphone screen.

To be blunt, I've had enough. I don't want my browsing flooded with this stuff, and don't accept that I should be tracked, tagged or

ABOVE Getting rid of pop-ups, pop-unders and banners can be difficult, especially on a smartphone

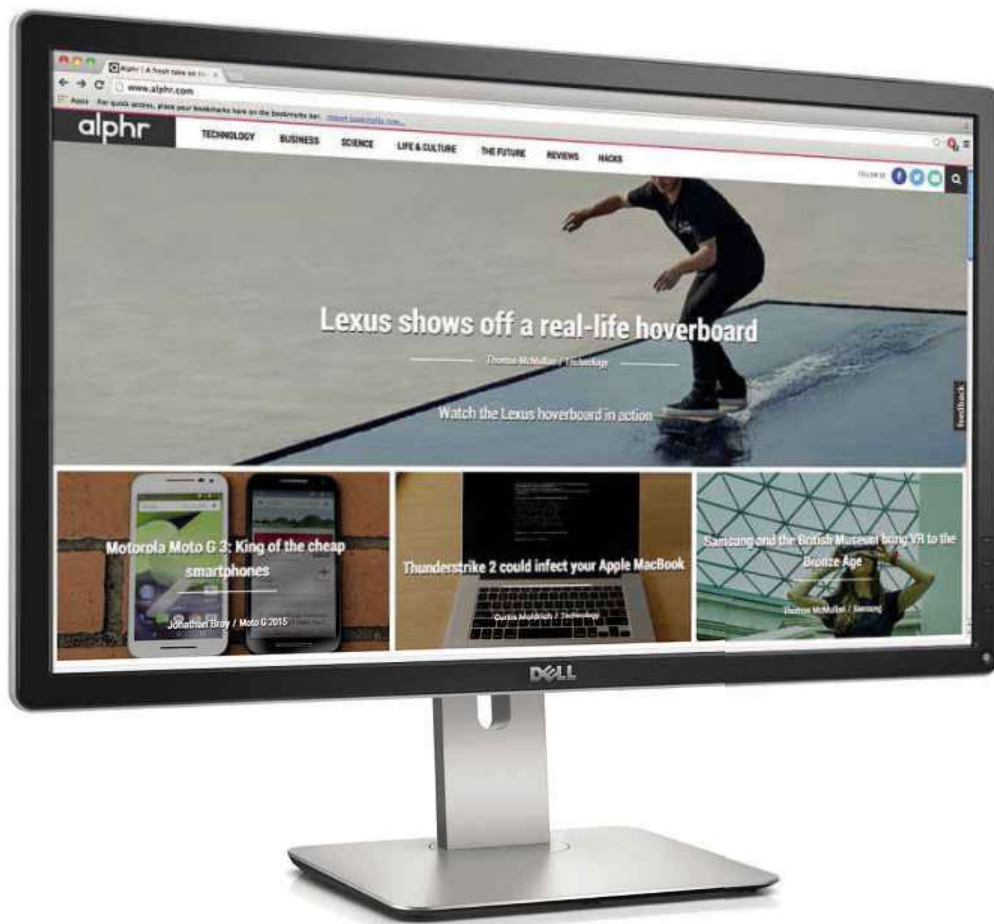
"Providing content as HTML-encoded text on a free website would be an absolute disaster"

monitored without my consent either. So I'm officially withdrawing my consent. There are tools out there such as Adblock and the fascinating Ghostery, which lets me see and block all hidden tracking technologies. Since I've applied these remedies, my browsing has been far snappier. I use less data when on my mobile phone, and pages appear, with the desired content, in a fraction of the time.

The problem is that this isn't a model that can work for the future. The last thing the industry needs is open warfare with its customers. In the interests of supporting commerce, I can live with a few of these things, but when the list grows as long as on the *Telegraph's* site, it's getting out of hand. This on a website that only offers a limited number of page views per month for free, before you get locked out and have to subscribe to their paywall.

The problem is that good material is expensive. Providing content as HTML-encoded text on a free website would be an absolute disaster, because it leaves no obvious way of making any money. The industry has, therefore, slid down a path of adding advertising and tracking data to gain both direct income from, and insight into, its readers. In doing so, it's arguable that they're killing the golden goose – the positive relationship between the reader and supplier.

Maybe the answer is to generate personalised PDF files on the fly, or



a similar technology that can deliver content without all of these coding dregs surrounding it. Otherwise, we run the risk of more solutions like Apple News, which aggregate content and may inject their own adverts into the stream anyway. More and more sites are treading the fine line between remaining acceptable to users and annoying them so they leave forever. In my opinion, I think it's worth looking at tools such as Ghostery. Understanding what's happening on a particular site is a good education, and may well explain the grotesquely long loading times and huge data transfers when you're only doing simple, benign browsing.

4K and OS X

I've decided to make the leap up to a 4K monitor for my Mac Pro, replacing one of its two Thunderbolt displays. I initially wanted to buy something really good such as a high-end Eizo, given the long and sterling service I've had from my Eizo 30in monitor, but the market seems to be moving too fast. Too many vendors are promising displays that curiously don't ever seem to come to market, or whose

price unsettlingly varies from week to week. I took the plunge by buying a relatively low-end Dell device, the P2761Q 27in Ultra HD 4K LCD monitor. It runs to 3,840 x 2,160 pixels, has a moderate 350cd/m² brightness, and offers both DisplayPort and HDMI inputs. At a little over £500, this unit seemed to be a reasonable toe in the water.

So far I've been quite impressed by the Dell. It isn't going to win any awards for colour accuracy, but I have colour-calibration tools in the lab to sort that out. It's not the brightest screen either, but it's adequate. Getting it to work with the Mac Pro was simply a matter of making sure I was on a recent version of OS X, because significant changes happened in the support of 4K monitors around April this year. OS X doesn't mind simultaneously running one screen at one resolution and DPI, and another with different settings. Some apps can get a little upset,

ABOVE The Dell P2761Q won't win any awards for colour accuracy, but it's a reasonable toe in the water

including VMware Fusion, but this will be fixed in an upcoming build. Furthermore, putting Windows 10 into a VM and then running it on the 4K monitor could end up with Windows getting rightfully confused about what was going on, although a few tweaks sorted that out.

Overall, it's worth taking a look at these high-resolution monitors, which are far sharper than standard HD and easier on the eyes over a long day. I wish Apple would release a nice 27in 5K monitor to go alongside the 5K iMac, but there's still no sign of that happening.

Meraki

My adventures in the land of Meraki continue apace. I now have all four of our sites using Meraki firewalls and Wi-Fi units. I've managed to set up a full-scale, pan-site VPN tunnel that allows anyone to connect to anything on another site. This lets me do all sorts of new things. For example, I have a NAS box on one remote site, which I update with core data from the main lab. I do this over a standard IP link, using the rather excellent Sync Folders Pro tool for OS X. I needed to update the firmware on a colour laser last week, and could do it from my desktop without having to drive down to the site. This has been possible for years, of course, but the way that Meraki configures and manages is so simple that it brings this capability to a much lower-end range of users.

I've also recently been working with my friends Jason and Tim at **bridge1solutions.com**, who are writing cloud-based solutions to leverage the amazing information Meraki can collect. For instance, the Wi-Fi unit in the main lab saw more than 2,000 separate devices just yesterday. These were devices in the immediate neighbourhood and undoubtedly included a raft of devices in people's cars as they drove past. Meraki collects all of this data, and you can then mine it to your heart's content. For example, they've written a solution that can track people moving in and out of a store, so that

BELOW Meraki devices bring new capabilities to a bigger range of users



you can make them special offers if they come back next week. The customer doesn't even have to be logged in to be tracked, as just the normal Wi-Fi browsing of a mobile phone is trackable, albeit anonymously. If the customer logs on to the shop's Wi-Fi, you can then start to interact with them.

This sort of data analytics is possible thanks to how the Meraki system collects data. You can disable this if you want, but it's an invaluable tool for a lot of shops, restaurants, petrol stations and other public places. This takes me back to my previous remarks about web-browser tracking: if you don't want to be visible to these systems, just turn off your Wi-Fi and Bluetooth! It's up to us to decide whether we're being tracked or not and, unfortunately, this is getting all too complicated. I normally go into a shop to buy stuff, so having special offers made available to me isn't such a bad thing. For some reason, it just doesn't feel the same as going to a website and being bombarded by adverts and tracking. It's strange how we feel differently about these things, depending on the context.

Microsoft Clutter

You might have noticed a new item called Clutter in your Outlook and Office 365 setups. This is a system that cleverly analyses what you're doing, what matters to you and to which emails you usually respond, and then automatically moves unimportant things into your Clutter folder. I don't like this sort of processing being done by default, because it's a change to my "world order". It would be far better for them to send me an email about this new feature, and ask whether I would like to try it for a fortnight. However, I have no problem with Windows 10 doing system updates without permission; far too many systems don't get updated because their user doesn't want them to interrupt their day. Moreover, Windows Update has been a real chore in the past, taking far too long and being a real pain. Hopefully Windows 10's auto-updating will be more sophisticated; otherwise users will just turn it off and we'll be back to square one.

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PAUL OCKENDEN

"The old joke about USB runs: 'Which way round does the plug go? The other way, of course.'"

Three quirky USB products have been surprisingly useful, from a reversible cable to a 5m-long endoscope

Last month I looked at three interesting USB gadgets and, as promised, I'm going to examine three more in this column. I'm looking at some of the more unusual, esoteric and downright useful USB gadgets that I've bought or had sent to me for testing over the past few months. I'm going to start with a very novel cable – in fact, it's unique. The old joke about USB runs: "Which way round does the plug go? The other way, of course." I know the odds are mathematically 50:50, but it seems that a USB lead is always upside down when you first go to plug it in.

Of course, this "wrong-way-up-ness" (I'm sure there's a technical term) isn't anything new. From the serial, parallel and SCSI connectors of old to the network, power and display sockets we use today, all cables have suffered from the problem. Ports hidden behind bits of kit somehow further increase the chances of wrong-way-up-ness. Some of the newer connectors such as USB Type-C and Apple's Lightning are symmetric and can be connected either way round, but most of us are stuck with old-fashioned USB (full-sized and micro) for the foreseeable future. And these



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BELOW As a result of last-minute changes, only the micro-USB end of the MicFlip cable is now reversible



are definitely "one way only" connectors – or so I thought.

Then I came across a video announcing a new crowdfunded cable and began to realise that things could be different. I probably paid more attention to the video than the product at first, as it's one of the best product introduction videos I've ever seen. In fact, have a quick gander at pcpro.link/253mw now, and then come back to this column when you're done.

As you've just seen, the product is a USB cable called MicFlip, which has fully reversible USB and micro-USB ends. At least, that was the initial promise, but there's a twist to the tale. The cable comes from WinnerGear, a company I greatly respect – its Montar car mount is probably one of the best phone holders on the market. If you've never come across this item, it's a beautifully made, sturdy mount far better than the cheap tat you normally find in "car kit" accessory packs. It fits all phones – from the smallest "ladyphone" to monsters such as the various Galaxy Notes and the iPhone 6 Plus. Best of all is its suction mount, which isn't the usual black rubber "lick it and stick it" type. No, this sucker is made of a gel-like material that lets it stick to textured surfaces such as a car dashboard, and comes with a 3M adhesive pad you can use if the surface is breathable.

It's a brilliantly thought-out and designed product, which is why I had such high hopes for the MicFlip cable and decided to get in touch with the company. The crowdfunding campaign on Indiegogo had only just started, but WinnerGear was very accommodating. It only had a single sample of the lead available – the one used in the video – but sent it to me. The only one in existence. This makes PC Pro the first magazine in the world to test it, and it worked very well on every device. It's great not having to worry about which way round the connectors are when plugging in.

It's a good-quality lead, too, with tangle-free construction, aluminium housings and gold-plated connectors, making it feel like a well-made, premium product.

Purists might complain that the device works by "abusing" the specification of the plugs themselves. USB and micro-USB are supposed to be a particular size and only have connectors on one side, according to the USB Implementers Forum Inc (a not-for-profit company founded by the companies that originally developed the USB). You can only insert them into "official" plugs and sockets when they're the right way round. The micro-USB connector is supposed to have a long and short edge, but the MicFlip plug has two short edges instead. You'd think this wouldn't fit into your phone or other device properly, but I'm happy to report that this isn't the case. It fits together very well, the connectors swap round when the orientation is reversed, and everything works as it should.

However, I mentioned a twist to the tale. It's great that WinnerGear sent me their only working cable, but *PC Pro* is not only the first magazine in the world to test it – it's the only magazine that ever will. Why? Despite my sample appearing to work fine, WinnerGear has struggled to get the production leads to work reliably. The micro-USB end is fine, but there have been disconnection problems at the main USB end and, as a result, the company is now shipping a version that's reversible only at the smaller end. That won't matter for most people, as the larger end will remain permanently connected to a PC or a charger, but the late-in-the-day change has upset a few of its crowdfunding backers.

I can understand their anger. The MicFlip would have been unique as an entirely flippable cable, while there are already other products and crowdfunding projects on the market that rotate just the micro-USB end. Check out Micro-Flip on Kickstarter or, if you don't mind ordering from China, you'll find the Prolink Dual Face cable for sale on banggood.com for less than £2.50. However, the MicFlip is a much nicer cable. It's obviously more expensive at \$15 (around £10), but I reckon it's worth



the extra money. I'm really hoping that WinnerGear will manage to solve the problem of making both ends reversible, forcing them to make another brilliant video!

Getting a fix

A few years ago, a chap who lived down the road and knew I was "into computers" would knock on my door every few weeks to demand that I pop round to sort out his PC. I'd leave it working perfectly every time, but, within as little as a fortnight, his machine would grind to a halt again under the weight of trojans, toolbars and other dodgy threats. It kept happening, despite him running current antivirus software. I shudder to think what sort of websites he used to visit or what software he'd installed to pick up so much malware in such a short space of time. I was never brave enough to look through his internet history!

He was also one of those people who can't take a hint. I started to gently suggest that my trips were becoming too frequent and that, if he insisted on visiting dodgy websites and installing spurious codecs to view videos, perhaps he could find someone else to look after his PC for him. I even tried wearing my very rude "No, I won't fix your f**king computer!" T-shirt for a visit, but he still kept ringing the doorbell. I even tried pretending I wasn't in if I knew it was him. I eventually solved the problem by moving house. Okay, I admit that I didn't move solely to get away from this chap, but it was a very welcome side effect.

ABOVE I really liked the video WinnerGear produced to promote its MicFlip reversible USB cable

"His machine would grind to a halt again under the weight of trojans, toolbars and other dodgy threats"

I've recently been sent a USB-based gadget that, had it been around then, might have saved all of those trips along the road. It's a clever little device called the FixMeStick. Readers with exceptionally long memories might remember that I once wrote about a product called the Yoggie Gatekeeper Pro (pcpro.link/253mw2), an ExpressCard that also came in a near-identical USB version called the Gatekeeper Pico. The device contained its own operating system and would do real-time virus scanning of all the data that arrived on your PC while it was running, using a Kaspersky scanner engine. However, it was way ahead of its time and, unfortunately, Yoggie went out of business back in 2010. The FixMeStick is similar in some respects: it's a USB device that contains not only a Kaspersky engine but also Sophos and Vipre scanners – meaning that all of your files are checked three times.

However, unlike the Yoggie device, it doesn't work in real-time or check data as it arrives from the internet, but is more of a traditional file-scanning product. You use it to get out of trouble if your PC has become infected. Like the Yoggie device, the FixMeStick contains a Linux operating system, but uses the OS to reboot your PC, rather than running it alongside the host PC. To use the device, you plug it into your PC like a USB memory stick, run an executable on the device to download the latest definitions for the three onboard scanning engines, reboot the machine and start up a Linux-based operating system session. At this point it connects

to the internet and tries to update the Linux build used on the device, as well as its various drivers.

This isn't an essential step, and in some instances – if you're on a protected network or using a mobile SIM-based data connection – the update won't be possible. That's not the end of the world, but driver updates ensure that the device can operate as quickly as possible. After performing these updates, it scans your PC and checks all drives, files and folders. On one machine I scanned recently, it found a Registry hack deeply embedded in an old recovery partition. The scanning process is completely independent of your machine's main operating system, meaning you can be sure there aren't any hidden processes hijacking access to certain files or masking malware.

The process can take a while, depending upon how much data you have on your machine and the speed of your drives. A dialog pops up to say "This might take between one and several hours", which made me laugh. It's accurate though. If one of the three scanning engines finds something nasty, it gives you the usual option of moving the files to quarantine. None of the options are particularly complicated, meaning there's no "what level of scanning do you want" or "what type of files do you want to exclude" – it just scans everything. This lack of complication makes the product perfect for the type of person who is likely to end up with an infected machine; that's probably unfair, though, as we've all picked up a virus from time to time. I'm still thinking of the man along the road!

There are two versions of the FixMeStick – a standard one for £45, which is licensed to scan up to three PCs per



month, and a Pro version for £215 that will work with an unlimited number of machines. The latter might be useful for an IT department, or perhaps "PC Doctor"-type operators. You get free updates for a year with each version, with renewals available later on. Incidentally, people often say that Macs don't get viruses, but that's simply no longer the case. There may not be as many Mac viruses as you would find with Windows, but they certainly exist, so it's lucky the FixMeStick is also available for OS X. It can't cope if you're using BitLocker or (the now defunct) TrueCrypt to protect your drives, but if you're savvy enough to be using drive encryption then you're probably not in the target audience for this device. It's more something that you might buy as a present for your dad – or perhaps suggest to that bloke along the road.

Careful where you stick that camera

My final USB gadget is something I bought out of curiosity, but for which I've since discovered a host of uses: an endoscope. Let's get the jokes out of the way quickly. No, I'm not going to stick it down or up any of my bodily orifices. Hopefully the readers of this column aren't like the majority of my friends, from whom I've had nothing but giggles, sniggers and titters when I tell them what I've bought.

I'm sure proper medical endoscopes cost many tens of thousands of pounds, but my device cost just over £6 on Amazon. It's basically a tiny camera on the end of a long (5m) cable, with LED illumination at the tip so you can use it to inspect dark places (stop titting at the back!). Various "inspection camera" or "snake camera" devices have been on the market for a while, but they're mostly expensive and usually came as self-contained units with battery pack, screen and so on. As a USB device, this cheap Chinese



ABOVE Proper medical endoscopes cost many thousands of pounds, but my device cost just over £6 on Amazon

"I'm amazed at just how useful the endoscope has been, especially when used with an OTG cable and a smartphone"

endoscope from Amazon simply plugs into any PC and, better still, if you use an OTG cable, into a phone or tablet.

Its image resolution is hardly spectacular, at 680 x 480 pixels. In a world where smartphones are starting to sport 4K screens, a 0.3-megapixel image sensor might sound laughable, but it's more than adequate for the kind of things you will be using it for.

There's some Windows software supplied with the device, but it seems to work with any application that expects a USB camera feed, such as Windows Movie Maker or most webcam software. On Android, just search Google Play for "USB Camera" and you'll find a plethora of suitable apps. The camera end of the endoscope is fully waterproof, and its focal length lies in the 70–100mm range, which is ideal for a device like this.

So what can you use it for? Well, since I've had mine, I've used it to peer down a plughole to see if a lost ring was trapped in the U-bend; I've looked into the gap in a cavity wall to see where various electrical cables run; I've attached it to a long pole to check the gutters, and I've used it to look at the wiring behind the dashboard in my car, without having to disassemble everything. I'm amazed at just how useful the endoscope has been, and I don't recall that any of these applications involved attaching it to a PC. The device is so much more convenient when used with an OTG cable and a smartphone. However, the device is definitely not suitable for medical examinations, which eliminates a worry I once experienced after being taken to hospital for a "both ends" endoscopy inspection: "I really hope they do the top first..."

LEFT The FixMeStick is great for rescuing virus-, trojan- or rootkit-infected PCs, and there's even a version for Macs

 @PaulOckenden

ROBERT SCHIFFREEN

“We rapidly discovered that SharePoint isn’t so much a product as a development platform”

It took four years, but the University of Brighton’s SharePoint installation now provides essential features for its 3,000 staff

Six years ago, the University of Brighton set out to create a web-based portal for its 3,000 staff. The powers that be made two crucial decisions: that Microsoft SharePoint was the way to go, and to use the unreleased 2010 version, rather than the 2007 flavour. I took up the new SharePoint farm administrator post in June 2011, and spent the next two weeks on the sofa with lots of strong coffee and a copy of *SharePoint Unleashed* – still the best series of books on the subject. After another week at Learning Tree’s training centre in London, we were ready to start building test farms.

Microsoft is pretty poor at getting people to understand what SharePoint actually is. The official line is that it’s a collaboration platform, but so is Twitter. I look at it like this: SharePoint lets you create websites, allowing people to upload and share information. It can be documents, images, calendars, traditional web pages, structured data you might find in databases or spreadsheets, or just about anything else. SharePoint works with Active Directory, meaning you can set permissions on anything from an entire document folder to a single record in a contacts list. It’s incredibly powerful.

As we rapidly discovered when we started building the system, SharePoint isn’t so much a product as a development platform. While it’s relatively capable of doing out-of-the-box stuff, building a working system and setting it up properly is either a multi-week task or one that requires assistance from expensive consultants. Frequently, it’s both. However, if the naked product can’t manage a task, hundreds of companies make add-ons that will help (called Web Parts in 2010 and apps in 2013).



Despite everything, Robert Schiffreen remains SharePoint farm administrator at the University of Brighton.

@rschiffreen

“SharePoint lets you create websites, allowing people to upload and share information”

RIGHT This is the end result of a lot of hard work: our current intranet homepage design

Just when you think you’ve got everything worked out, you discover you haven’t. The incredibly powerful search facilities work best when every document has assigned metadata and a content type: for example, “this document is a policy or a user guide, not simply a Word document or a PowerPoint presentation, and was created in the HR department”. This means revisiting all your documents, information architecture and search config options so users can say “show me all the policies HR have published in the past 93 days”. They’ll love being able to do that, by the way, but don’t underestimate how long it takes to do properly. Or how horrible a death the inventor of XSLT-based config files deserves to die.

One decision we got absolutely right was to make all our servers virtual, within our VMware infrastructure. This goes against

the advice of some experts, especially for the SQL server, but the advantages have far outweighed any negatives.

It’s quick and easy to take a full snapshot of a VM before undertaking any maintenance work, and it’s just as quick to revert if the work fails. This has saved our bacon on more than one occasion. Our current production farm comprises five servers (one web front-end, three application servers and one SQL server). There’s a similar layout in our pre-production farm too, albeit with a lower spec. This is all in-house, rather than in anyone else’s cloud. If a server is underperforming and could do with some extra RAM or CPU cores, a friendly chat with our VM team is all it takes.

Setting out our aims

During the initial planning phase, which took many weeks, we identified three major aims for the SharePoint project, based both on best practice and maintaining a service with a familiar structure for our users. First, a SharePoint site for each staff member where they could store “personal” university documents, namely those not relevant to other colleagues or students.

Second, an area we christened “My Department”. It’s similar to the personal site, but with just one for each department. This would allow staff in each department, school or

faculty – around 40 in total – to collaborate on documents. All staff in the relevant department would have permission to access that site, but their colleagues in other departments would not.

Finally, a replacement for our ailing StaffCentral intranet, an area where departments could publish information and documents that were potentially relevant to all staff. For example, HR might publish pay scales and rules about annual leave. Every employee would have read access to all of StaffCentral, and staff in each department would also have write access to their area.

Designing the permission levels, deciding which subset of SharePoint’s 41 permissions would be applied to each user, was



essential but proved irritatingly time-consuming and confusing.

SharePoint has a fixed hierarchy when it comes to creating sites, so we also needed to decide how to map our desired structure into the SharePoint way of doing things. At the top of the tree is the web application, which has a unique root URL. Within each web app you have site collections, and within each site collection is one or more sites (known as subsites).

We settled on three web apps, hosted at staff.brighton.ac.uk, mysite.brighton.ac.uk and mydepartment.brighton.ac.uk. SharePoint creates each user's personal site as a site collection, and this underlying structure can't be changed. By design, each user is granted full admin permissions to their site collection and is allocated both a private document area and one shared with everyone else in the organisation. We needed neither of these things: this meant a couple of weeks of PowerShell scripting to ensure that new staff members were automatically allocated resources that fitted our requirements, not those of Microsoft.

Many SharePoint experts advise that personal sites are the least-used part of any SharePoint rollout and suggest that you consider them last. In our case, users were clamouring for the ability to access their work documents remotely – something our previous system didn't allow. This desire was a huge driver for SharePoint in general, and personal sites in particular.

In the MyDepartment web app, we gave each school, department or faculty its own site collection, and adopted a similar layout in the Staff web app. Subsites allow further granularity, which helps allocate permissions. For example, the subsites for payroll, recruitment and pensions are in the HR department's site collection. Not everyone in the payroll team needs permission for the pensions subsite, making setting permissions easier at this level.

Once again, I developed PowerShell scripts to create new departmental site collections. Although this took a considerable amount of time and planning (the script that creates a MyDepartment site collection has to configure more

than 40 different things), it was definitely the best method. This was partly for consistency, and partly because there are certain things that can't be done via the admin GUI and can only be achieved with scripting.

Coming up with the finished software architecture of web apps, site collections and subsites sounds easy, but in reality, it took several weeks, lots of research and some serious schmoozing with SharePoint experts at conferences. As with everything in SharePoint, every decision has numerous repercussions and, if you don't know about these beforehand, they're likely to come back to bite you. Most of our planning meetings included at least two mentions of Donald Rumsfeld's famous phrase about the "things we don't know we don't know".

For example, SharePoint stores all its content – user documents, web pages, permissions data, search crawl indexes – in Microsoft SQL Server databases rather than flat files. A site collection can't span more than one database and, when we installed SharePoint 2010, it wasn't recommended to allow a database to grow to more than 200GB. Had we decided to implement the entire MyDepartment system as a single site collection, rather than a web app, all 40 departments would have had to share 200GB. Microsoft has subsequently revised the figures to upwards of 1TB per database, but managing such large files and backing them up is painful and something I intend to avoid.

While storing all content in SQL databases may seem a strange way of doing things at first, it does have its advantages. I can be confident that a

```
Administrator: SP Mgt Shell
PS C:\uoh\build-mydept> .\build-mydept.ps1
Set alternate css url for root site

Creating rstest2 explicit managed path
Creating p.mydepartment_rtest2 content database
Creating rstest2 team site collection owned by university\sa
Setting rstest2 quota to 200 GB
Set alternate css url
Setting theme to Summer
Enabling publishing infrastructure feature for site collection
Removing Unnecessary Permission Levels
Removing Unnecessary Permission Level Assignments
Creating UoB MyDepartment Reader permission level in rstest2 site collection
Creating UoB MyDepartment Admin permission level in rstest2 site collection
Creating UoB MyDepartment Contributor permission level in rstest2
Security group 1 not specified
Security group 2 not specified
Setting root portal URL
Hiding workflow tasks library
Hiding site collection images library
Hiding site collection documents library
Hiding Images library
Hiding Customized Reports library
Hiding Form Templates library
Hiding Pages library
Hiding Style library
Hiding Content and Structure Reports
Hiding Reusable Content library

All Done
PS C:\uoh\build-mydept>
```

ABOVE Using PowerShell for site collections allowed much more flexibility and consistency

"I fully expect that we will be looking after ten million pieces of information within the next couple of years"

BELOW Virtual servers made it much easier to change the specification if demand spikes

database backup of any particular site collection contains all of the necessary files, metadata and so on. It's possible to use a feature called Remote BLOB Storage (RBS) to move large document files out of the databases and replace them with pointers to a traditional file on a network share. However, the SharePoint community is awash with horror stories about what happens if the two storage systems ever get out of sync.

Where next?

SharePoint at the University of Brighton has now been up and running for around three years and is proving to be a huge success. Migration from older systems continues, but we're taking the time to do it properly and to work with each department to establish the correct metadata types and underlying information architecture.

Right now, the new StaffCentral intranet receives around 85,000 hits a week and the collection of SQL content databases comprises around 2TB of data. The MyDepartment web app currently contains 850,000 files. StaffCentral holds 30,000 and MySites comprises 1.96 million. I fully expect that we will be looking after ten million pieces of information within the next couple of years.

The next stages of the project for my team include a refresh of the intranet's design. We're also actively researching whether or not we should upgrade to SharePoint 2013, which is released and established, or 2016, which has only just been released for testing. Plus, we're exploring ways of using SharePoint's workflow features to modernise existing business processes currently being driven by paper-based forms and complex procedures. One thing's for sure: we've come a long way since the days when I was lounging on my sofa, reading *SharePoint Unleashed*.

r.schifreen@brighton.ac.uk

General	
Guest OS:	Microsoft Windows Server 2008 R2 (64...
VM Version:	7
CPU:	4 vCPU
Memory:	32768 MB
Memory Overhead:	242.42 MB
VMware Tools:	Running (Current)
IP Addresses:	172.17.1.30
DNS Name:	ASTERION.university.brighton.ac.uk
EVC Mode:	Intel® Westmere Generation
State:	Powered On
Host:	
Active Tasks:	
vSphere HA Protection:	Protected

DAVEY WINDER

“Spooked by the LastPass breach and want to manage passwords offline? Here’s what to do”

Many people are distrustful of online password managers – and it seems they may have a point. So how can you keep your passwords secure?

A research paper titled “No-one can hack my mind: comparing expert and non-expert security practices” (pcpro.link/253rwc1) grabbed my attention recently. Written by three Google researchers – including Dr Iulia Ion, an expert in strong authentication – its abstract suggests that “average users” and “security experts” are miles apart in their thinking. Non-experts think in terms of antivirus software and regularly changing strong passwords, while experts primarily focus on prompt installation of security patches, two-factor authentication (2FA) and strong, unique passwords controlled by manager software.

There’s so little overlap between these perspectives that average users may overlook 2FA, patching and password management completely. They’re not getting it wrong, but could certainly do better by, for example, adopting a password manager. The authors encountered scepticism from non-experts, who preferred remembering their passwords via other methods that were perceived as less easy to hack, such as writing them down or simply keeping them in their head. Given the recent and lamentable security breach at password manager LastPass (pcpro.link/253rwc2), you might be forgiven for thinking they have a point.

As someone who’s regularly recommended LastPass for both personal and small-business use, I’m sticking to my guns. It’s always serious when a prime target such as LastPass is breached. Email addresses and associated password reminders were stolen, leading to a rash of phishing attacks trying to snare master passwords. More worryingly still, the per-user salts and authentication hashes were also



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“Average users may overlook 2FA, patching and password management completely”

accessed, potentially leaving users with weak master passwords vulnerable to brute-force cracks opening up their password vault. Notice I say “potentially”. That’s because LastPass strengthens those authentication hashes with a random salt and an additional 100,000 rounds of server-side PBKDF2-SHA256 hashing. They could still be cracked if the initial passwords were very weak, but it would take some time. Even so, LastPass forced most users to change their master password – 5,000 new rounds of hashing created a new key, which was then hashed again by “x” number of iterations (“x” being a parameter you configured for your account) to generate the key used to encrypt and decrypt your vault data. This key was hashed again before being sent to the server (which never sees the encryption key) to be salted and hashed 100,000 times more, yielding the stored authentication hash stolen by the hackers.

Furthermore, LastPass asked for email verification from users logging in from a new device or IP address, but users who were already implementing multi-factor authentication weren’t asked to jump through these extra hoops. For example, when I use a YubiKey token, an attacker has to break my master password and get

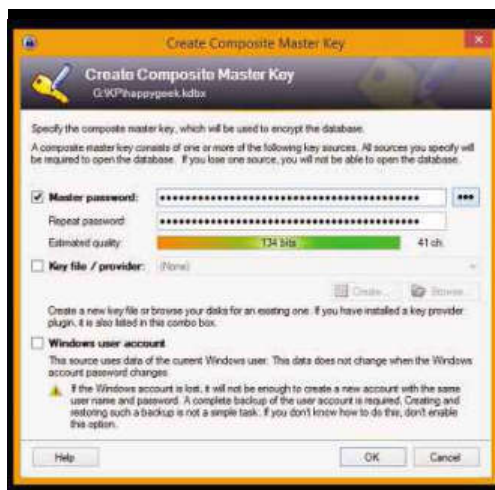
hold of the physical key in my possession. Free 2FA through the Google Authenticator app is also available, and would also stymie would-be attackers if – as LastPass has emphatically stated – the encrypted user vault data wasn’t compromised. When you consider how open the company has been about this breach, I have no reason to disbelieve this.

If you’re a LastPass user, you can also implement a geographical access lock-down using the advanced configuration settings. This enables country-specific access restrictions. I keep mine set to UK-only, meaning all access attempts from anywhere else are disallowed until changed before heading abroad on a business trip. There’s another useful advanced tweak that lets you disable logins from Tor networks, a typical access route for would-be attackers.

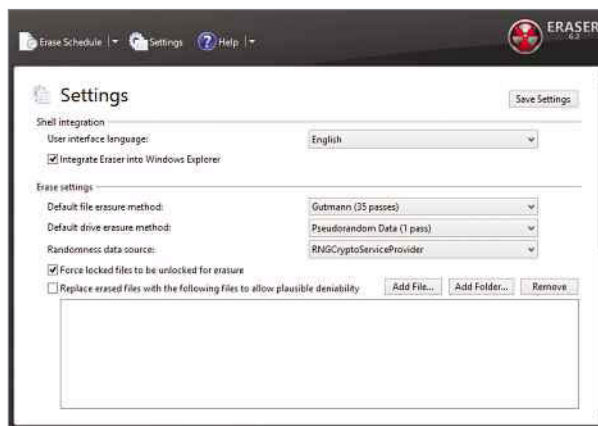
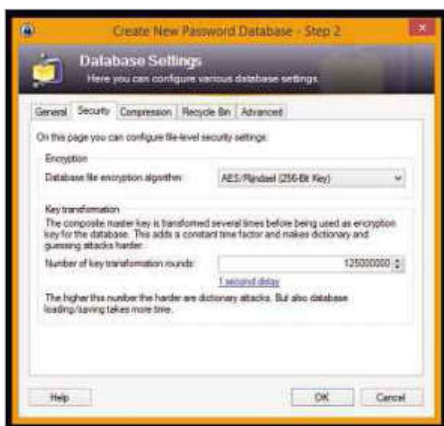
However, this still doesn’t mean all is rosy in the LastPass garden. A question remains over how the hackers breached network security in the first place and, despite LastPass’ openness, some users have voiced concerns over the implementation of its response. I’ve heard that users who had changed phones or laptops needed to verify their new devices before being able to log in (basic security practice), but the verification was sent via email to an account – yep, you guessed it – secured by LastPass, so the users couldn’t get the verification link! The only workaround was to use whatever system their email provider had in place to recover an account with a lost password. Judging from my mailbag, this gaffe has alienated a small group of people who are asking me what they should do next.

Going offline

My first instinct is still to recommend an online password manager. I’ve always been a big fan of 1Password, another online product that syncs across devices. But I’m encountering resistance to any recommendation for cloud password management, even if it’s easy to use. So, if you’ve been spooked by the LastPass breach and want to take your password management offline, what should you do? As I’m addressing prosumers and small businesses on limited budgets, the options are fairly limited. You could consider the



RIGHT One password to secure them all



Qwertycard I looked at in issue 251, but if you want a “proper” offline password vault, I’d steer you in the direction of the open-source KeePass.

KeePass supports multiple users, but all working via a single database stored on a shared network drive, with file-system access rights used to restrict write access. Unfortunately, you won’t find any per-group access control lists, so all users will have the same master password and get read access to the same database. This is not a way I’d recommend using KeePass, but it’s adequate for a one-man-band business, or for a user who doesn’t need to sync across devices or set up multiple user rights. There are ways to do these things, but they tend to be complex and don’t really do the job you want – or they involve third-party apps and the cloud you’re trying to avoid. For a single user, assuming you’re not too fussed about the in-browser automation of logins (again, third-party add-on required), you only need three things to take offline control of your passwords: KeePass, a USB stick and VeraCrypt.

Download the portable version of KeePass 2.x from pcpro.link/253rwc3 and install it onto your USB stick. Plug the USB into any Windows computer and then run it – there’s no need to install (the device you’re plugging into will need a .NET framework). There’ll be no new Registry keys, no config files in the Windows or application data directory of the logged-in user, as long as they have write access to their own application directory. Getting started requires nothing more than a download, unzipping and the File | New Dialog prompting for a composite master key. This is the master password that will be used to encrypt the database, so make sure it’s long and memorable.

That’s not as difficult as it sounds, and can be done using many different methods, such as using a passphrase complete with spaces between the words. You could always pay a fiver for a Qwertycard and use it solely to

unlock your KeePass vault. The Qwertycard (qwertycards.com) fits in your wallet but remains cryptic to anyone but you. Its unique spacebar code is combined with a secret word or phrase – the only bit you need to remember – and is topped off with a site-name code transposed using the card. If someone got hold of both your Qwertycard and your KeePass USB stick, they still couldn’t decrypt it without the secret phrase in your head. That’s assuming they know that you’ve locked your KeePass database with it in the first place. Given this unlikely combination of factors, the risk of compromise is very low indeed.

Now you just need to head to File | Database Settings | Security, and configure your vault’s encryption – the default 256-bit AES/Rijndael is good enough. Combine this with a serious number of key transformation rounds, which make cracking harder by transforming the composite key before it’s used as the encryption key: something like 125 million provides a good balance between the added security and the delay in opening or saving your vault.

Now you can start to add entries. Take a look at the included samples to get an idea of the interface – everything’s pretty self-explanatory. I suggest you use the key icon to the right of the password box to open up the password generator. Migrating from LastPass used to be problematic, but most of the import glitches have now been fixed. From LastPass, head to Tools | Advanced Tools | Export To | LastPass CSV File. This will create a text file you can save in CSV format. Then, in KeePass, select File | Import and scroll down to LastPass CSV. Choose your file, then, once the migration is complete, delete it using a tool such as Eraser (pcpro.link/254rwc4) and let KeePass do the rest.

It’s not perfect by any means, and you’ll need to tweak some entries, but you can use it

ABOVE LEFT It’s worth using a lot of transformation rounds

ABOVE RIGHT Don’t forget to erase your CSV password file after migrating

“This double-whammy makes the chances of anyone getting at your passwords pretty remote”

BELOW Use VeraCrypt to encrypt a password store kept on a USB stick



to make sure your passwords are suitably complex. You don’t have to do them all at once (start with email accounts, as they’re the most commonly compromised routes to other credentials) but create a routine of changing a few every day over the coming month and you’ll soon have the task finished. Just remember, don’t reuse passwords and stick to unique

phrases for everything, keeping the strings random and lengthy. The built-in password generator enables you to do this with ease – although some services persist in limiting password strings to eight characters or disallowing non-alphanumerics – and make them at least 25 characters long. What you won’t end up with is something that’s automated like LastPass, so don’t expect cross-device syncing or automatic login entries, unless you want to start entering the territory of add-ons and apps. These, frankly, dilute trust and increase the risks of using KeePass. I’m not saying that any of the add-ons and ports found on the KeePass site are unsafe, just that you have to trust these third-party developers. Every time you allow an external application to access your database, you’re increasing the risk of something going wrong.

That said, there’s one more thing I’d add to the mix: VeraCrypt. It’s the open-source encryption program that has taken off where TrueCrypt left off (see my column in issue 251 for details, and download it from veracrypt.codeplex.com). But why would you need to encrypt your password database twice? Well, my thinking is that you should encrypt your USB stick using VeraCrypt. If you were unlucky enough to lose it, any chancer or even an experienced attacker would have to crack your stick’s encryption before cracking

your password vault’s encryption. This double-whammy makes the chances of anyone getting at your passwords pretty remote, if you’re using unique and complex passphrases in both instances. There’s one more thing to do, and that’s back up your KeePass data file to another encrypted USB stick for safekeeping. As you keep this updated – and remember we’re only talking about cutting and pasting one file – you’ll always have a copy of your passwords if you lose the original. This would be a bad thing, but the double-encryption approach

Continued from previous page



ABOVE Set your password parameters in the generator box and let KeePass do the rest

would soften the blow and give you plenty of time to access the backup and change your passwords.

Do I need to encrypt Facebook?

Talking of encryption, Facebook has introduced support for OpenPGP. But it's not quite as good as it seems: for starters, its OpenPGP implementation of choice is GNU Privacy Guard (GPG). Earlier this year, Facebook injected \$50,000 into the pocket of GPG's creator to keep the project going after he revealed he was running out of cash to keep it alive. So far, so good – apart from the small fact that PGP isn't known for being user-friendly, and GPG isn't the friendliest of its unfriendly variants. It's far from straightforward, thus ruling out the vast majority of Facebook users from ever implementing it. Not that it's a huge disappointment, since all Facebook is offering to encrypt are the notification emails it sends you, assuming you're one of the few people not to have switched those off years ago. Sure, it's useful if you need to request a new password, but not for the tedium of "Fred just posted to the Watching Paint Drying Appreciation Group". Facebook also uses HTTPS by default to provide SSL/TLS encryption, meaning that virtually all traffic to the social network is over a secure connection – requiring no effort on the part of the user.

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STEVE CASSIDY

"Microsoft's five pillars of successful network design are dropping far too many IT guys into hot water"

Even Microsoft admits a hybrid approach is best – but to make it work, you need to understand the company's unspoken rules

This month I'm going to talk about five things that Microsoft should have made clearer. This means getting technical – the sort of technical that, were I more like an archetypal consultant, I'd be wanting to keep to myself. But I've come to realise that Microsoft's five pillars of successful network design are dropping far too many IT guys (and the networks they support) into hot water, to the detriment of their careers and the businesses they work for. Are things really that risky? I'd have to say they are.

There are clear use cases to be made for cloud computing, that marvellous phenomenon that causes all those happy blokes down the pub to hold forth about the wonders of Office 365, and all those super-happy IBMers to flaunt their massive (but hidden) compute farms. The clearest winners from cloud computing are those at the top, with tens of thousands of users, and those at the very bottom with fewer than five. At the medium scale, though, things get messy. There Be Dragons. There's no shortage of people who think that the cloud is a "journey" – one they're impatient to complete, because they're confident there's no downside. They have no evidence to back such confidence, nor any Plan B if it turns out they're wrong. But Microsoft figured out Plan B at least 18 months ago, when it switched from saying "cloud first" to saying that "hybrid" was very likely to be the right answer.

Hybrid has been around as a concept for a very long time, first mooted by Ray Ozzie and Paul Maritz in their roles as the Gandalf and Saruman of the cloud agenda. But it's always been by far the hardest of the three original options to implement. In practical terms, to make hybrid computing work, you need to make your entire network fully compliant with the



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right way of doing things. Not right according to your own research; not right according to ten million lost and helpless mutual-support forum threads; right according to the way Microsoft thinks it should be done, yet hasn't made clear at all.

Why does this need to be done? Because we've all moved on from the simple environment that cloud computing appeared to need. Reliance on general computing, not just in the cloud, has risen dramatically over the past few decades: you can't run your business on next door's unsecured Wi-Fi and a Hotmail account nowadays. You have to factor in failure at your connection provider and host when planning ahead, and that demands more local computing smarts than was the case even two years ago. Notice that I said "smarts", because mere speed hardly matters any more, and storage is practically free by the standards of the last decade. What matters now is age and resilience: your network needs to be smart enough to keep your people working on the worst of bad days.

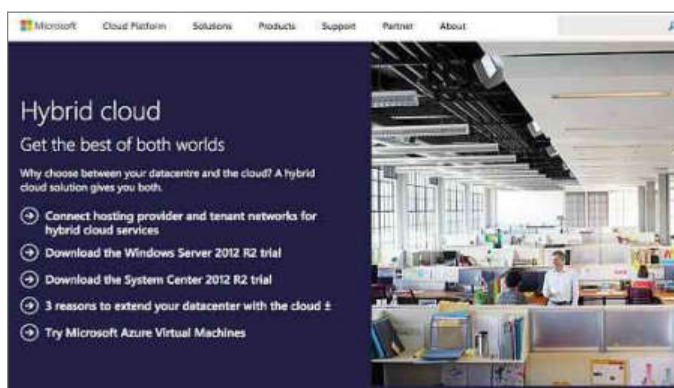
The 5 great unclarities

So, what are the five most widespread LAN mistakes that occur because of a lack of clarity in Microsoft's advice?

1 Who owns DHCP?

It's perhaps the easiest of protocols to set up, and therefore often the least attended to in the long-term life of a

BELOW Even Microsoft seems to have admitted that hybrid is the right answer



network. All DHCP does, according to the web, is pick an unused network address and issue it to a device that wants one. Sounds harmless enough, and many tiny networks do what the instruction leaflet says and set up their router to provide these addresses. But this is where the problems start, because the provision of addresses has become much more interesting since the rise of Wi-Fi and the advent of ever-larger networks.

DHCP is now a way for Wi-Fi access to be controlled by a dedicated device that hands out addresses to wireless clients. In bigger networks, DHCP can become like a crack-dealer, an insurgent, an evil penetrator of carefully built security solutions, just because some chump turns up with one of those USB Wi-Fi micro-stations so that his smartphone can connect to the corporation's link.

If you're running Microsoft PCs talking to a Microsoft server, then that server wants to use the DHCP database to validate that the PCs listed there are all friends. The delays caused by the server and PCs forever gabbling to each other to verify security requirements may seem like overkill, especially when there's no doubt about identity, but this process is neither optional nor up for discussion. Sidestepping the Windows DHCP server provokes all manner of irritating and apparently unrelated problems such as fluctuating populations on browse lists, slow copying of files, inexplicable requests to re-enter damn-fool passwords and failure of single sign-on. I've yet to find a single network – even one where VoIP phones get their addresses from the Windows server – where there was an actual technical barrier to letting Windows do its thing, as distinct from a personal preference or some weird global-politics-based piece of dogma.

2 DNS outside the LAN

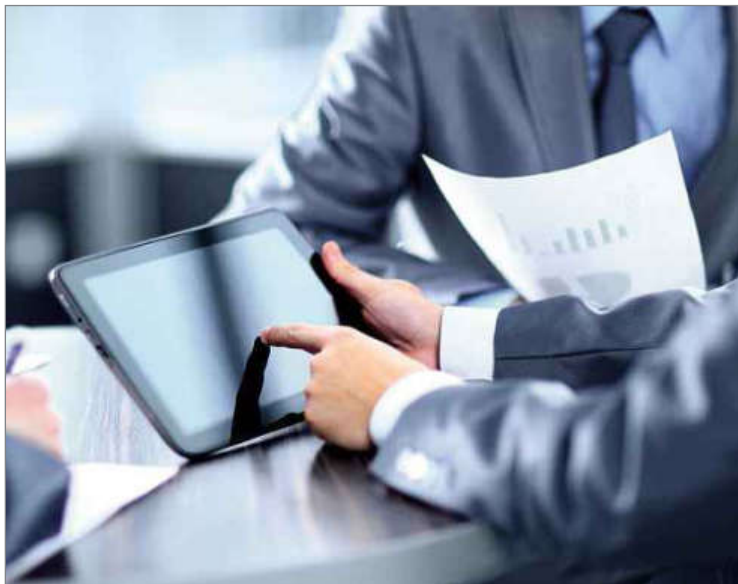
This is very common now in businesses that operate with only tablets and smartphones. They have almost no files stored locally, and if they do they're on a NAS device that probably spends most of its time streaming music. For this kind of business, there's no need to have any local resources at all, because they want everything to be globally accessible and believe that any resources inside their place of business will be cut off from the rest of the net by the security needs of their firewall or ISP. This outlook has consequences, naturally, and I find that most of these guys live with performance that would

have had me climbing the wall and asking for a refund even back in 1997. They also spend around four times as much on web design than they ever would have done on buying a small server and a few CALs, which is pretty poor payback for the amount of management, explanation, quality assurance and even litigation that this necessarily entails.

I know that's a lot to infer simply from not having a DNS inside your business, but it's still a handy benchmark for a certain level of technical commitment, and a strong sign that the proprietors want to keep control of both their company information and their contractual relationships. A properly set-up copy of Windows Server 2012 Essentials will run a DNS for you, and let you add nice names for things, using perfectly well-understood standards. You'll even be able to carry on working when your hosting company has a hissy fit or your web guy is found locked in a dungeon in Zurich run by the Hell's Angels (allegedly).

The most common confusion I encounter these days on the subject of DNS is whether yours needs to be configured with your one and only brand name, and whether it should also be responsible for answering any lookups made by any curious person anywhere on the planet. Lots of less reputable web guys will say such configurations are the kiss of death for internal DNS, which strikes me as pretty rampant sales nonsense: if you're **alphr.com**, then there's no reason at all why your internal LAN DNS name can't be **local.alphr.com**, and no outside requesters will ever know any different.

With a DNS added to an otherwise 100% Windows network, lots of security nonsense stops being a problem; the sole exception is the state of any NAS boxes you may have in your network. To say that the NAS marketplace isn't hot on standards is a gargantuan understatement, an elephant in a telephone box: each NAS may or may not want to own the entire network address space, may or may not want to hook you into its own poorly described cloud backup service, and may or may not want to



ABOVE Businesses that operate on mobile devices often end up with performance I would have been disappointed with in the 1990s

“Sidestepping the Windows DHCP server provokes all manner of irritating and apparently unrelated problems”

maintain your username and password lists (despite dialogs and web management pages that claim otherwise). To my mind this doesn't entirely disqualify them as usable business tools. However, it does change their status from the core of your in-house storage solution to an optional extra that helps back up other things, and divides fast and small files from slow and big ones. I've yet to see a NAS offer any kind of DNS service that does more than parrot what your external supplier's DNS gives you anyway. Whenever I see a network with just a NAS and hear how much money it's saved them, I tend to bite my cheek and wait for the phone call.

3 Samba madness

Nothing to do with dancing, unless you count dancing around the truth. The plain fact of the matter is that SMB – often called “Samba” when you're reading about non-Windows servers and file systems – is Microsoft's own in-house protocol for servers and workstations to talk to each other and move files around. The company has never said that SMB can or should be open-sourced, nor entered into any arrangements with NAS vendors to guarantee long-term compatibility. There have been updates – SMB3 in Server 2012 R2 brought a significant performance boost, to take but one example – and there are even offshoots such as CIFS. However, if you come across a NAS vendor that requires you to download Registry patches for the (Windows) PCs that use their NAS, then you're asking for trouble. Generally speaking, I've found that such a hack-and-patch approach delivers you

a very particular kind of pain on the next big Patch Tuesday, when Microsoft decides to reverse the configuration your NAS vendor has supplied. Weirdly, given that SMB is Microsoft's baby to do with as it sees fit, blame for these bad days never seems to land at the right door (that is, the NAS vendor). Again, whenever I hear a business loudly proclaiming that their £1,200 storage box can't possibly be in the wrong, and that the fix certainly could never be a £300 PC with a £300 server licence and £300 of enterprise-grade SATA drives in it, I wish them luck and leave them my business card.

4 Not enough servers

"We had a lot of trouble with the server" they say, "so we moved to the cloud." Single-digit counting is a common reaction to excessively techie sales pitches (and, to be fair, also to the early adopters of largely experimental, cluster-based, multi-server environments), but I've yet to meet a techie who feels this is a terrible slight upon their character. That's mainly because having only one of anything is a licence for techies to print money – cue all those war stories about rolling back to the old config in the wee small hours of the morning, or restoring SBS servers from scratch and then spending weeks unravelling the consequences of recreating all the user logins and security groups.

It's nuts to stick with only one of anything – be that a server, a NAS, an internet connection or a cloud service. With physical servers, you're utterly dependent on it all running well, all the time; with cloud services you're dependent on several distinct factors, such as the financial health of your cloud provider, the physical wellbeing of their hosting centre, the tested nature of their recovery procedures, and even how important you are to them as a customer.

I encounter this "count of one" problem so often that I've concluded there's a kind of business owner who actually needs something to worry about, and thinks that might as well be IT. Increasing your counts, by going from even the smallest server up to a pair, or mixing a server and a NAS, or having some of your gateway servers hosted on Azure for instance, is the easiest way I know to keep your



egg-to-basket ratio at a sensible level. I realise this can add licensing costs, but my point remains the same. Microsoft has never made this a huge secret: it may have made it a trifle incomprehensible, but never actually secret. And there's never been a time when Microsoft's terms and the reality of activation and pricing have been so good for the customer as they are now.

5 24/7 and shadow copy thinking

This particular sin is one for rather larger businesses. It's the one that got me thinking about this whole topic, after reading Mr Mitchell's excellent in-depth critique of the feature set of the Netgear NAS he was battling with a couple of issues ago. His problem was that when operating as an iSCSI volume, this Netgear disagreed with the provision of shadow copy services on the volumes it was presenting.

Shadow copy is one of those services that drew a great deal of techie attention when it first hit the street; it seemed to get around many of the limitations of working with servers that have to be continuously available. This was like catnip for both system designers and salespeople: everyone's experienced the anxiety of downtime, and everyone likes to think their people can't exist without some systems to talk to. So we have add-ons and entire structures devoted to ensuring that nothing ever stops, not even for a backup.

This is all well and good in those sectors and at those scales where it was first invented, but once this notion of 24/7 availability escapes into the wild, that's when trouble starts. A full-scale user of a differential backup product that

makes use of shadow copy systems is definitely not operating at a scale where they daren't touch their lone and creaking server. Which is just as well, because an in-depth reading on the subject of playing with shadow copies will quickly reveal that Microsoft never intended them to be a long-term sole store for all your data. Many resources end with the advice to delete and recreate the misbehaving volume, or even to erase and reload the misbehaving server – neither of which are happy outcomes if you've bet your entire business on that single

point of failure and thought that incremental shadow copies would offer the right way out of any trouble.

This could be a corollary to rule 4 about not having enough servers. Really, though, it's yet another odd example of me ending up criticising a feature even though it's actually been bent a long way out of shape in order to perform the role it's used for out in the wild. Ancient IT wisdom comes into play here, too, about not mixing your test and production environments, and about how long it takes you to move all your data from place to place. But my advice about buying into totally continuous availability remains the same – it's a big boy's toy that only really starts to work when all the other toys are present in copious and high-performing numbers.

This brings me neatly back to the most recent shift in overall advice from Microsoft – the thing about how hybrid computing is the way of the future. This is leap-forward advice: you can see how many of the shortcomings that I'm finding out there – be they cloud or old-school local computing – all converge on the same answer. It's much easier to run an under-populated local network when you have some Azure VMs in the mix, and it's much easier to switch cloud suppliers if you have some local resources and local copies of your data and website as bargaining chips. All of these scenarios fall under the hybrid computing description, and I expect that's what Microsoft has been driving at for the past few years. The next big question, of course, is whether Windows Server 10 will help to attain this goal.

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"It's nuts to stick with only one of anything – be that a server, a NAS, an internet connection or a cloud service"



How 3D-printed rats could offer schools a vegetarian dissection

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We explore the trends and technologies that are set to shape the future

Drones and the law

Air-traffic rules are struggling to keep up with drone technology **p127**

Geek Day Out

Visit one of the world's largest telescopes at Jodrell Bank **p128**

What is... 3D XPoint?

Understanding Intel's new memory breakthrough **p129**



The future of smart cities – now

Canary Wharf is running a series of smart-city pilot projects. Are they a peek into the future of urban life? **Nicole Kobie** investigates

Nearly 30 years ago, One Canada Square erupted out of east London's Docklands to give us a glimpse of the skyscrapers that would come to dominate the city's skyline. Now, Canary Wharf is a testbed for the technology that could dominate the next three decades.

Many cities now deploy smart technology to power traffic lights and other mundane utilities, but Canary Wharf is piloting projects that cover

anything from helping cafés work out how many sandwiches they'll need to cover the lunchtime rush to traffic-management systems that stop cyclists getting injured by delivery trucks; from solar-powered benches with built-in Wi-Fi hubs to floors that collect kinetic energy.

The pilots are the result of the Cognicity Challenge, a series of competitions for Internet of Things (IoT) projects. It's organised by the

ABOVE Canary Wharf is piloting a range of Internet of Things projects and schemes

Canary Wharf Group and the consultancy firm Entiq. "We were bored of having so many people dwelling on what a smart city is, and thought 'let's try it out'," said Gaia Arzilli, head of communications and engagement for the project at Entiq. "We are talking about an estate that is 27 years old, and really wanted to think, 'how can we be at the forefront of innovation for the next 27 years?'"

BELOW Flow.city offers a sort of Google Analytics for physical retail spaces

The Cognicity Challenge was supposed to have six winners, who would each be handed £50,000 and a chance to test their projects in



Canary Wharf. Instead, seven winners were selected and the estate decided to trial 14 of the 36 projects pitched. It's a reward that could eventually be worth far more than the £50,000 prize money, as the estate is genuinely looking to sign smart-city contracts for its existing buildings, and a new residential development in Wood Wharf.

■ Magical management

Given the sky-high office towers that make up the bulk of Canary Wharf, it's no surprise that several of the projects involve skyscraper management. For example, Future Decisions' predictive algorithms help building managers peek into the future to estimate energy and heating consumption and run office towers more efficiently. They can even run without human interaction by using custom-made sensors, "talking" to other connected buildings and sharing data.

However, the plans extend beyond the office towers. Boldmind's Flow.city offers smart signage, which developers say is like bringing Google Analytics to physical retail spaces. It pulls in data from many sources, including Apple's iBeacon and other sensors spread throughout a building, as well as information from CCTV feeds, public transport, social media and local events. It can count how many vehicles are in the car park and how many people have passed through a corridor, building up a picture of what the lunchtime rush might look like and helping local businesses make marketing decisions.

If it's sunny, shop owners may offer a lunchtime takeaway picnic deal. If everyone is tweeting about a local evening event, bar owners can advertise a special to draw punters to have a drink beforehand. Is the Jubilee line down? Restaurants can offer a discount to encourage commuters to wait out the Tube delays over dinner.

Boldmind cites the example of the sushi shop Itsu. The data collected by the Flow.city system identifies when the building the shop is located in is still 30% occupied because people are working late, and a notification is shown to the staff via a mobile app. To draw in the business of overworked local employees, the owner can easily post an advert on networked screens around the building to offer dinner at a discount. If the ad works too well – the sushi sells out or there's a large queue – it can advertise on in-store screens that its nearby sister store has the same deal.

The data collection and analysis are intelligent, but the display side is simple. The Flow.city hardware is a small device that plugs into an HDMI socket, networking it to the



Bristol's smart-city lab

Canary Wharf isn't the only smart-city testbed. Bristol has been studying smart-city concepts for the past five years, treating its streets as a test lab. "Our goal is to make the experience of visiting, living or working in Bristol more sustainable, efficient and enjoyable," Kevin O'Malley, partnership innovation manager for city innovation at Bristol Futures, told *PC Pro*.

Bristol has tested a range of technologies: from smart energy meters and air-quality monitors to autonomous vehicles. That includes a high-speed network: "The 'Bristol is Open' network connects the city centre using high-speed fibre, Wi-Fi and wireless technologies, enabling large and small businesses to trial and develop new digital products or services," said O'Malley. "The network also connects the university's supercomputer with the Planetarium. The Planetarium has new 3D HD projectors that allow audiences to interact with visualisations of real-time data feeds from our platform."

Citizen feedback has been built into the process, and the response has been largely positive – and has lent an element of fun.

"The 'Hello Lamp Post' project let people in the city communicate with urban objects such as lampposts, postboxes, and bus stops via text message," O'Malley said. "Over two months, tens of thousands of conversations were held with street furniture in the city, and the project has now gone international with projects in Japan and the United States."

Next up, the city is looking at energy and transport, as well as improving health and social care. "The key to creating a smart city, though, is not in the experimentation but through mainstreaming the technologies that really work," he added. "So lots of our efforts will be in sharing the results of our work, to encourage mainstream take-up of the most effective and impactful technologies and approaches we have come across."



LEFT The sushi shop Itsu uses the Flow.city system to draw in business and make offers to local office workers

system – almost like a Chromecast for physical behavioural advertising.

■ Smarter trips

It's not only human traffic that's being tracked around Canary Wharf. Voyage Control efficiently schedules delivery lorries coming into the estate, using spare capacity to limit traffic-clogging trips.

It's a software system that the developers compare to booking a seat in a theatre or restaurant. Currently,

lorries show up at random, meaning there is sometimes a queue and, at other times, the loading bays are empty and the staff idle. With Voyage Control, drivers book a space and time to arrive using a mobile app, so they know they won't have to wait. The recipients, therefore, can have the right staff on hand to meet the lorry. The vehicles themselves are tracked by a mobile app on the drivers' smartphones, meaning no dedicated or proprietary hardware is necessary,

"Voyage Control efficiently schedules delivery lorries coming into the estate, using spare capacity to limit traffic-clogging trips"

though Voyage Control is also working with companies that make tracking devices for freight.

Voyage Control acts like an Airbnb for extra space in lorries. The

company estimates that as many as 30% of lorry trips waste space. The Voyage Control software helps redistribute deliveries so fewer trips have to be made, leaving extra space in another lorry making a delivery.

Voyage Control has already teamed up with one of the other pilots. The 8point3 smart lighting system aims to cut energy consumption by 80% by replacing incandescent and fluorescent bulbs with LEDs that can be remotely triggered by sensors or other smart systems, such as Voyage Control's lorry tracker. At the moment, loading-bay lights are often left on all night. The 8point3 system can grab data from Voyage Control's app, automatically turning on lights when trucks are due to arrive, which saves energy and directs drivers to where they're supposed to go.

■ Light it up

Other projects harvest energy, rather than conserving it. Polysolar is trialling photovoltaic panels on a bus shelter to collect solar energy, while Pavegen's floor tiles collect kinetic energy from the people walking on them. Each time a tile is stepped on, it generates an electrical charge, which is used to immediately power lighting and signage, or is stored in batteries for later use. The tiles can be retrofitted into existing flooring and daisy-chained to each other, with the wiring running through the tiles themselves. Not only

RIGHT Pavegen's tiles can be retrofitted into existing flooring and daisy-chained into each other



BELOW Strawberry Energy benches are both a Wi-Fi hotspot and charging area



does Pavegen collect power, it also gathers data, with sensors in the tiles tracking foot traffic.

The idea has already been piloted on the estate, and a ten-tile walkway powers two streetlights outside Canary Wharf station. The tiles could also be used in one of Canary Wharf's shopping malls. The technology was used in West

Ham station during the 2012 Olympics and has powered corridor lighting at Heathrow airport.

■ Food for thought

Strawberry Energy is probably the most noticeable idea in Canary Wharf. It's a futuristic looking bench, with an arm arching above it. The limb gathers solar power to let users charge mobile phones via a pair of USB ports, built-in charging cables and even wireless charging. It's also a Wi-Fi hotspot, so you can take a break from the office, charge your phone and check your Facebook feed at the same time. Displays show local information, air-quality levels and feature an emergency call button.

Four of the Strawberry Energy benches are set to be rolled out in Canary Wharf at the end of the summer, and the designers hope they will spread across London – a hope likely echoed by tourists, phone fanatics and everyone else prone to finding themselves without a connection or with low battery on their smartphone.

■ Streets ahead

While all 14 of the pilot projects being tested in Canary Wharf are fascinating in their own rights, it's likely that many will fall by the wayside. They have to pass the challenges facing all IoT projects: interoperability, privacy, security and genuine utility. That said, Arzilli points out that smart cities aren't just inevitable, but have already arrived – the challenge-winners all needed to be technologies that could be used on the existing estate, not just the new residential block. "We've moved away from the idea that smart cities are something that's going to come in the next 25 to 30 years," she said. "Smart cities are already here." ●

The ethics of smart cities

Are smart cities good for the people who live in them? "That's a question we can't really answer yet, but it needs to be considered," said Kevin O'Malley, partnership innovation manager for city innovation at Bristol Futures.

"We need to be looking closely at the ethics of what we propose to do with this powerful technology," he said. "We could, for example, tag and monitor everyone in the city who has dementia. This is technically possible and would ensure that they could be traced if they became lost, but is this an ethically justifiable use of the technology?"

Bristol has established a steering group to address the ethics of the data collection, but it's worth remembering that smart city projects may benefit one party to the detriment of another. "The costs might be an over-dependency on technology, but the opportunity to address issues such as traffic, suburban sprawl, crime, pollution, water management, energy management, and education through new financial and collaborative models appears to be significant," argued Craig Bachmann, senior director for the open digital programme at industry association TM Forum.

However, it's difficult to judge the true costs of smart cities to the people that live in them, which is why it's so important that smart-city trials receive citizen feedback. "Cities are places where we live, work and play," said O'Malley. "We need

the involvement of citizens to bring that life, creativity and playfulness into our future cities because, without putting the human experience at the heart of these programmes, we could end up knowing the location of everything but the value of nothing."

Tied into this idea are security and privacy. Bachmann said these were "priorities number one and two of almost every smart-city initiative" he speaks to. It's only a matter of time before smart cities are hacked: for example, smart lighting and traffic controls are already used by many cities, but, at the RSA security conference in April, a talk by IOActive Labs revealed that 200,000 traffic control sensors were vulnerable to hackers.

That's a serious problem because smart city systems can be difficult to update – rolling out patches to your PC may be annoying, but imagine doing the same for an entire metropolis' worth of technology. Plus, security researchers can easily get their hands on a Windows laptop to test for vulnerabilities, but it's harder to do the same with bespoke smart-city systems.

O'Malley said the work in Bristol has revealed exactly how dangerous data collection could also be to privacy. "Data is the fuel that powers smart cities – it is ubiquitous and constantly growing," he said. "Obviously this data has the potential to be misused, so it needs to be properly managed and protected."

Droning on: the laws affecting high-flying cams

Laws frequently trail behind technology, but could new airspace rules ground drones or will they help them take to the air?

Drones are swarming into the skies. Not only are consumers snapping them up in record numbers, but Facebook has unveiled solar-powered aircraft for delivering internet connectivity, while Amazon is trialling drones for airborne deliveries.

Consequently, governments are racing to write laws to control the use of drones, by both companies and individuals. "The law has been struggling to keep up with the pace of advancements in technology," noted Paul McElroy, a lawyer at Osborne Clarke.

In June, MEP Jacqueline Foster published a report looking into drone laws, calling for rules to ensure the safety of the public. A House of Lords committee also suggested that commercial drone operators should have to register their devices on a database.

■ Legal droning

There are already laws governing the tiny aircraft. Commercial users need permission from the Civil Aviation Authority (CAA) and must show that they're "competent" at flying. The CAA has also unveiled a "Dronecode" for personal use, which lays out rules to keep people safe and avoid accidents with planes – there were seven near misses at Heathrow in the past year alone. The CAA says drones can't be flown within 150 metres of a congested area or within 50 metres of a person, and must rise to no more than 400ft in altitude.

The CAA has already punished irresponsible drone flyers. In 2014, an individual was fined £800 and ordered to pay costs of £3,500 for flying a drone too close to the Jubilee Bridge in Cumbria, and for flying over a BAE submarine testing facility.

Some drones are also covered by privacy legislation. "Many drones have cameras attached,"

said McElroy. "Another potential issue is recording images of people without their consent, breaching data-protection laws or the CCTV code of practice, which was extended this year to include public use of drones where they collect information about individuals."

■ Holding back technology?

At the moment, commercial use of drones remains at the embryonic phase, and governments appear receptive to changing laws to encourage their development. "Over the next year it seems that more companies will start using drones for commercial use," said McElroy. "We will therefore see more changes, with companies making proposals that could shape the law."

Those companies include Amazon and Facebook, which are both working with US authorities to resolve legal issues. "Although this has been confined to the US, similar proposals are likely to be made in the UK," said McElroy.

Other companies that are considering the use of drones include Network Rail (to boost mobile network coverage on trains), oil and gas companies (for inspections), and even Coca-Cola (for delivering messages to workers). One Russian marketing agency is even using drones to promote adverts in Moscow, bringing a whole new meaning to "advertising flyers".



Crowdfund this!

Our pick of UK tech projects on Kickstarter and Indiegogo

Smart&Tough Stealth 4G smartphone

Another smartphone, just what the world needs.

Save your gadget ennui – this isn't your average smartphone. The Smart&Tough Stealth 4G is a rugged phone that the makers claim is tougher than other hardened handsets. The unibody frame is made using a new injection moulding technology that combines magnesium alloy and hard plastic. It makes the chassis tougher but also lighter than rivals. Plus, it's waterproof and has toughened glass.



Who's behind it? The handset is being made by a development team in Manchester – none of this hipster East London nonsense. The project video shows the Stealth 4G being repeatedly dropped from a height, left in a stream – we often forget ours in the local babbling brook, too – and even recording video from the bottom of a rock pool.

It sounds like it would survive a typical night out in Manchester.

The makers have suggested that it's sleek and powerful enough to be at home in the office, but also tough enough to survive a day strapped to your bike handlebars, being shunted around in the bottom of your toolbox, or in the sand and "sunshiiiiine" at the beach. It might even endure a shopping trip around the Arndale Centre.

What are the specs? The Stealth runs a pure version of Android on a 1.2GHz quad-core chip and 2GB of RAM. The 4.5in display has a resolution of 1,280 x 720, and it has a 13-megapixel rear camera. The phone also has dual SIM slots and supports external storage via a microSD card, supplementing the 16GB of in-built memory. Moreover, the developers promise that the 3,300mAh battery means you'll get a full day away from the mains. And, as the name suggests, it's 4G.

Remember the failed Ubuntu phone? Is this actually going to happen? This isn't the team's first phone, with previous models picking up awards, and there are already working prototypes. Plus, the crowdfunding money will only be used for material costs, not development, and it will ship in just six weeks from when it's funded – fast for such a project. At the time of writing, it had secured a fifth of its £50,000 goal from 44 backers.

I'm mad for it. What's it going to cost me? The early bird price of £120 has already sold out, so at the time of writing you'd have to shell out a reasonable £160. The full price at retail is expected to be £399.

LINK: pcpro.link/253smart



Geek Day Out: Jodrell Bank

Reach for the stars at Jodrell Bank, home of the third-largest steerable telescope in the world

There are many reasons why a trip to Jodrell Bank is a day well spent for families, but here's one you may not know: mobile phones must be switched off at all times. That's because the signals interfere with the on-site radio telescopes, which are sensitive enough to detect a Nokia on Mars. So, if nothing else, you'll part your children from their devices for a little while.

However, the main attraction at the Jodrell Bank Observatory is the Lovell Telescope, the third-largest steerable telescope in the world. "It's a sight to behold and it's particularly remarkable to see it move as our scientists observe different parts of the universe," said Lorna Harper, head of business performance at the Jodrell Bank Discovery Centre.

There are also plenty of other exhibits to take in. "My personal favourite is our clockwork orrery, believed to be the largest of its kind in the world," said Harper. "It shows the planets of our solar system moving at their relative speeds and positions. It's a beautiful piece that helps you discover more about our place in the solar system."

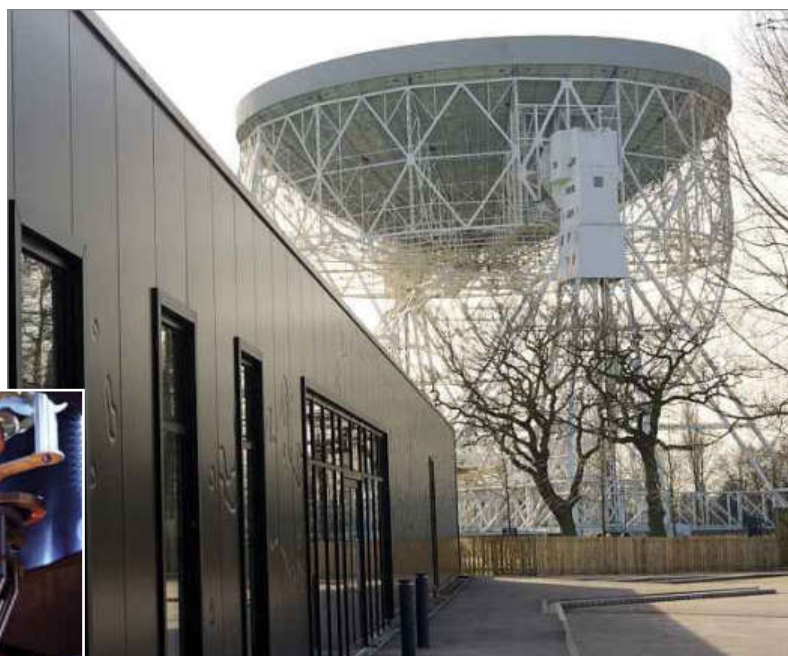
Not sure what an orrery is? It's a mechanical model of the solar system, and there are plenty of experts on hand to answer such questions about the exhibits, or the science behind them. "Our exhibition is staffed by



'Explainers', who are qualified physicists and can answer complex questions in a clear, user-friendly manner," said Harper.

If you go on a sunny day, should one ever occur again, you won't be missing out on the good weather. Jodrell Bank is also home to an arboretum, complete with a national collection of trees and a "galaxy garden" that uses plants to show how the universe formed.

While the research into quasars and radio astronomy may appeal more to older students, the Jodrell



ABOVE The steerable Lovell Telescope is a sight to behold

LEFT The clockwork orrery is thought to be world's largest

RIGHT Explainers are on hand to answer any questions



Bank Discovery Centre has something for everyone. "The information we share is conveyed in a simple enough manner to be understood by children, yet complex enough to keep adults interested," said Harper.

There are also events specifically aimed at children, including astronaut-themed shows during the October half-term break. "Backed

by the UK Space Agency, science centres across the country have joined forces with the European Space Agency's first British astronaut, Tim

“There are plenty of experts on hand to answer questions about the exhibits, or the science behind them”

Peake, to provide children with a unique opportunity to learn about human space flight and follow life on the International Space Station," said Harper.

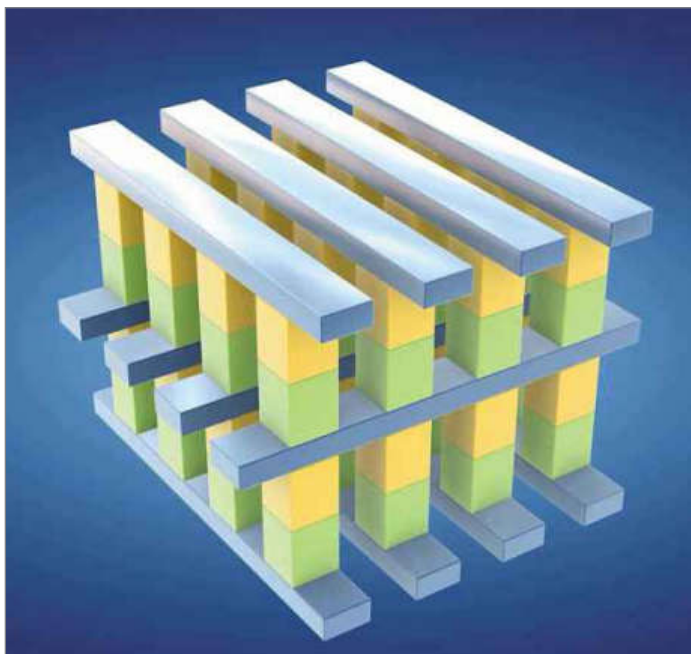
The Jodrell Bank Discovery Centre is in Macclesfield, Cheshire, and is open from 10am to 5pm daily. Tickets cost £7.50 for adults and £5.50 for children, with student, over-60s and off-peak discounts available. For more details, visit jodrellbank.net. ●



LEFT There are educational shows aimed at both children and adults

What is... 3D XPoint?

Intel and Micron have created a new type of memory, which they claim is 1,000 times faster than flash storage and will arrive on sale next year

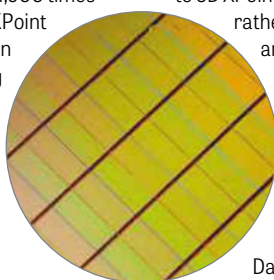


What is 3D XPoint and is that really what it's called?

It's not as catchy as flash memory, but it's better than what's in your SSD. Intel says that 3D XPoint, pronounced "cross point", is the first "mainstream" memory technology invented since 1989. The aim is to eliminate the bottleneck between storage and processing. DRAM is fast, but it's expensive and volatile, and wipes when your device loses power. The NAND found in SSDs is cheaper and non-volatile, but can be 1,500 times slower than DRAM. 3D XPoint is 1,000 times faster than NAND – while remaining cheaper than DRAM.

How does it work?

The 3D design packs a lot into a small footprint, allowing every memory cell to be accessed without transistors. 3D XPoint is made of columns, each with a memory cell and a selector that says if a cell can be written or read. Every column is connected by criss-crossing wires, meaning you can address an individual cell by selecting the top and bottom wire. It's stacked vertically to maximise efficiency, and has ten times the storage density of DRAM. To write to a cell, simply change the voltage of the wires.



So it's better than NAND?

It's faster. NAND's dependence on transistors means data can only be written in blocks. 3D XPoint can address each memory cell with small amounts of data, so it's much faster.

Will this replace PC memory?

Intel doesn't think so, and predicts that 3D XPoint will be used alongside existing technologies, as a "pool" of memory to speed up performance. Programs can move data in advance to 3D XPoint to help it load faster, rather than copy it from an SSD or hard drive to RAM. That means key data can be accessed faster than before – handy for memory-intensive tasks such as gaming, ultra-high-definition video and "Big Data" analysis. It can also boost boot times, when used to store OS files.

When will 3D XPoint arrive?

It's already being manufactured. Intel and Macron have said that products with the 3D XPoint technology will go on sale next year, but one important detail is missing: the price. We expect 3D XPoint to show up in expensive high-end gaming machines before it filters down to normal laptops.

Best of **alphr.com**

Our sister site Alphr covers the latest in tech and science – here are the top stories from this month on the innovations that are just over the horizon

Largest plane ever will send satellites to space

Microsoft co-founder Paul Allen and SpaceX's Elon Musk are among the big-name funders behind the Stratolaunch, the largest plane ever built. It will have an epic wingspan of 385ft and six engines, and will take to the skies for testing next year, in the hope of becoming an airborne launching pad for satellites, which will be fired from the Stratolaunch in mid-air.

pcpro.link/253alphr1



Is PlasticRoad the future of streets?

Tarmac is so old-fashioned. That's according to construction company VolkerWessels, which has created roads made from recycled plastic. Rotterdam is already considering trialling the new road surface, which will last up to three times longer than existing materials, work in a wider range of temperatures, and be quieter and smoother for cars. The roads are easily laid and are hollow, providing space inside for cables and pipes.

pcpro.link/253alphr2



The house that makes more energy than it uses

Cardiff University researchers have built a three-bedroom house for £125,000 that will generate £175 worth of energy for every £100 it uses, thanks to a roof made of solar panels. These power the heating and electrics, storing excess energy in batteries. The innovation came just as the government dropped its carbon-neutral home goal, with George Osborne saying it was "impossible".

pcpro.link/253alphr3





A minty fresh install of Linux makes Windows 10 seem tired and stale, says Jon Honeyball

A few months ago, it was the 30th anniversary of Frankie Goes to Hollywood's seminal album *Welcome to the Pleasuredome*. There was a special remastered box set produced through crowdfunding, and some of us went to Sarm Studios in west London for an evening playback of the album and a Q&A session with producer Trevor Horn and his team. It was a great event, one to be treasured.

Why, aside from bragging rights, am I mentioning this? It's because the track "Two Tribes" has a sound sample of someone pretending to be Ronald Reagan saying "war breaks out and nobody turns up" – which is exactly how I feel about Windows 10. Alright, it's here. It's a huge step forward from the unmitigated disaster that was Windows 8. I get a good feeling of Schadenfreude reading back reviews and postings from the Microsoft fanboys and girls who said 8 was "truly great". No it wasn't, and I wasn't afraid to say so.

Of course, I can discuss all the good new things in its successor but, at the end of the day, does anyone care? Almost more importantly, *should* anyone bother? "Microsoft launches Windows 10 and nobody notices" would be a fitting remake of "Two Tribes".

I installed a recent build of Linux Mint 17.2 with the Cinnamon desktop today. And guess what, it's really quite nice. It still has flashes of geekery in places, but that's almost charming in 2015. Hooking it up to my old HP Color LaserJet 5500 on the network was a piece of cake: it found the driver, installed everything I needed and just worked. Installing Chrome was equally stress-free. It comes with a whole bunch of useful software, including the full LibreOffice suite, which does a very good job of pretending to be an older version of Microsoft Office – the one before the hairdressers got involved and restyled it. In fact, maybe I should call the most recent Office "The Bouffant Edition"?

It also has a decent mail client, and good support for almost everything really. It boots quickly and installation is a breeze, taking only a few minutes to get itself up and running.

Again, I am left with the thought that this is really rather good, quite productive and a little bit hair shirt, in a charming sort of way for an old

See our guide to Linux distros on p34

“So far, nothing has scared me or caused me to wince, which is a big improvement on the Linux builds of old”

tech crony like myself. So far, nothing has scared me or caused me to wince, which is a big improvement on the various Linux builds of old.

Then I look at all of the data-slurping going on in Windows 10, and think to myself "is this really where I want to go?" and "is this really what I want"? I have to be honest with myself and wonder if it really is the best option.

At the end of the day, Microsoft has come up with a better 64-bit Windows 7 in Windows 10. I can take or leave the ability to run Metro apps (or whatever they're called this week) in a window, and don't find the new Start menu to be that overwhelming either. That said, the underpinnings are definitely better, with more solid support for the latest hardware. All of these things are undoubtedly good, but I still can't shake of a big feeling of "meh" with all of this. I should be thrilled that Windows 10 is free, but I know that Microsoft would have no hope of getting people to upgrade if it cost them money. That time has passed. Nowadays, far more people use

Android for real day-to-day work, and those who have bigger budgets use iOS. For laptops, I'll take Apple over anyone else thanks to the hardware, and OS X is more than good enough for what I need to do when I have to sit in front of a real computer.

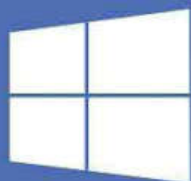
So, despite the huge engineering effort to get Windows 10 ready to ship, I'm still unenthused. Windows 10 Mobile isn't even close to shipping

and, when it does, it will impact just 2.5% of the marketplace – very modest indeed. I also just can't get myself enthused about Windows 10 on an Xbox, sorry.

Then a perky little chappy called Linux Mint strolls along, which is both much better than I thought it would be and really quite fun. It doesn't try to trick me every which way about my data, privacy and so on. There isn't an end-user agreement that runs to pages, with all its associated worries. It's good enough to let me get on and do my work, my way, and for me – without the feeling that someone, somewhere, is viewing me merely as a profit centre.

I guess I'm just getting old. Of course, I will install Windows 10 onto all my Windows 8 machines as quickly as possible, to rid myself of the lingering nasty smell. Windows 10 is good enough, but I fear even that's not enough anymore.

■ Jon Honeyball is a contributing editor to *PC Pro* and MD of an IT consultancy. Fox's Glacier Mints are his preferred minty treat. Contact him at jon@jonhoneyball.com



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